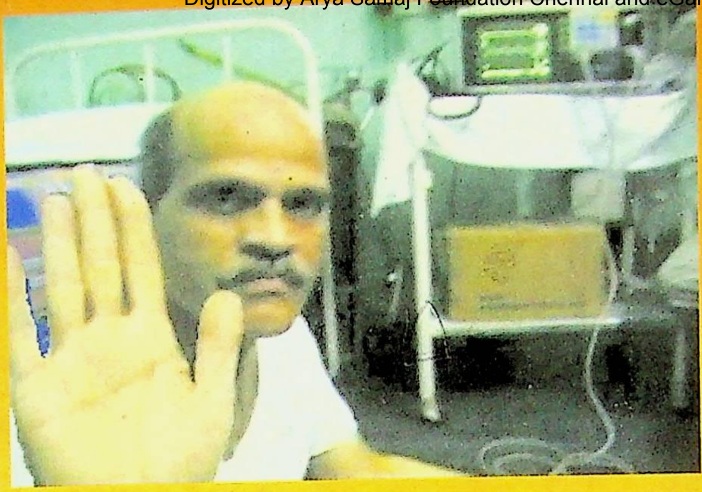


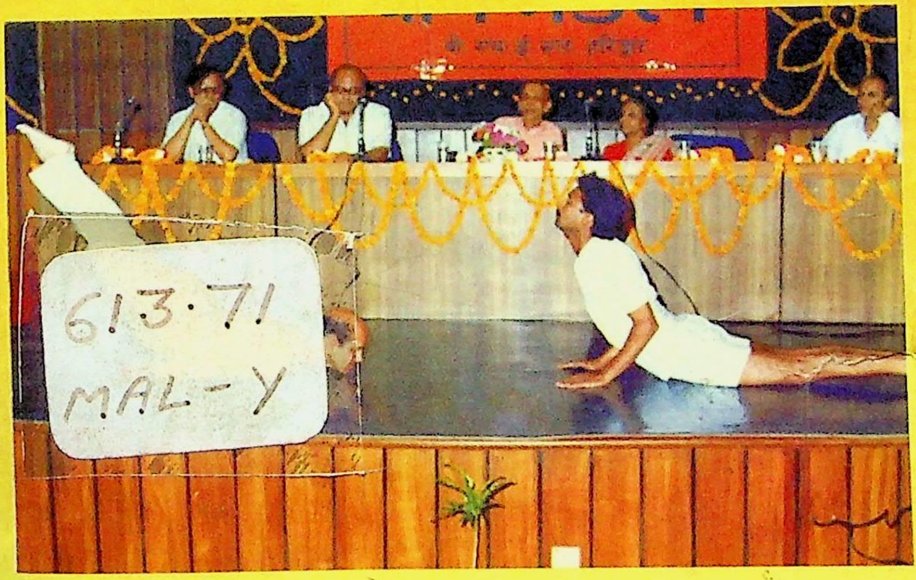
धारयेदवहुयत्नेन कुम्भकेन जलन्धरैः ।
यावत्स्वेदं नखकेशाभ्यां तावत्कुर्वन्तु कुम्भकम् ॥
घेरण्ड संहिता-5/59

Gheranda Sanhita 5/59

'Hold the breath with great effort closing the glottis. Breath-holding should be repeated till sweat appears at the nails and the hair-roots.'

YOGA BOOK *For Doctors*

Dr. Prakash C. Malshe, M.D.



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5. A parasympathetically stateis much desi modern cardiologi of the eyes which recommended in yog help producing suc Convergence is asso miosis which is a para activity.

6. There are further wa parasympathetic domi and inhibition of sympathet nervous system. They include inducin tears from the eyes (Tr inducing vomiting by gagg further more.

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M.D.

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I am indebted to my Guru -from whom I learnt the initial steps in yoga- revered **Swami Adhyatmanand ji** of the Divine Life Society, Rishikesh; for extending me his blessings without which it would not have been possible to present this book. I am thankful to Respected Dr. Vishnudutt rakesh ji for his poetic translation of the Vedic Mantra "Om Jivema Sharadah Shatam..."

I have drawn my inspiration to write a book from these works: *God Of Small Things* by Arundhati Roy, *Vedic Mathematics* by revered Jagadguru Swami Bharti Krsna Tirthaji Maharaj, and *Five Point Someone* by Chetan Bhagat.

I am grateful to my elder brother Prof. Vinod C. Malshe who has himself authored a book on paints technology and who always encouraged me to write a book on the subject of my liking.

I am thankful to my students especially Miss Rakhi Gihara who features in some photoes and Bhaskar Anand for his immense help.I am thankful to my colleagues Dr. R.K.Gupta, Dr. Ram Sharma, Dr.Vipin Premi, Dr.Sateesh Chandra, Dr.Rajiv Sikund and his radiographer Mr. Pradeep Sharma for the help rendered in my studies. And also to my English teacher Mrs. Dev and two computer professionals Sardar Jasminder Singh Chopra and Ms.Nutan Bhatnagar for their prompt help.

I am also thankful to my wife *Saubhagyawati* Leena for bearing my long absences from home, and my children Rohit and Priyadarshini who took away my worries by concentrating on their studies.

Dr. Prakash C. Malshe, M.D.

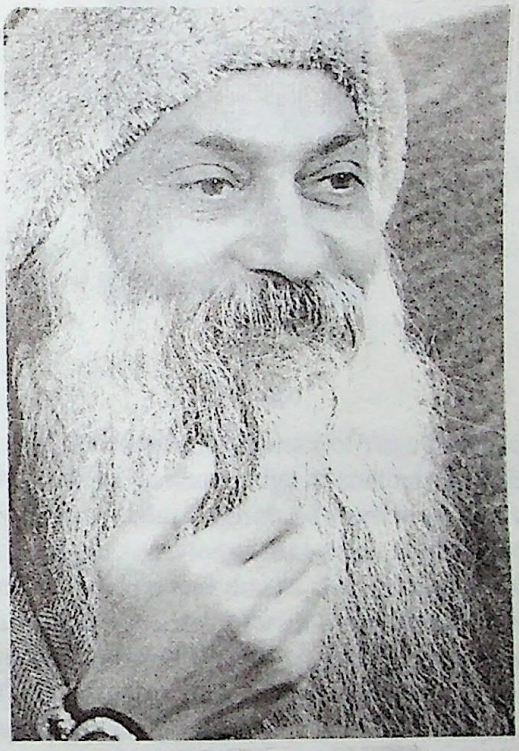
Presented to the future generation.....

Priyadarshini and Rohit, year 1987

Yoga is to be practiced everyday.....
It is a way of life.....
To keep physically and mentally fit, to live long and happy life and to achieve the spiritual ultimate.... Variously called as enlightenment or God.

Dedicated to

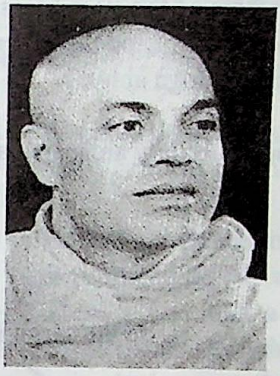
Osho



Who gave me the name Swami Antar Prakash and from whom I learnt to interpret the scriptures as they were told originally by their creators; without regard to the other interpretations.

ॐ

Swami Adhyatmananda



ॐ

Message

Learning or teaching the science of Yoga (Hath yoga) needs very essentially the basic knowledge of anatomy and physiology. Now when yoga has become household word in all four corners of the world, it is always good to practice yogic postures with proper understanding of its do's and don'ts. For example, *Shirshasana* (headstand) is simply wonderful for all-round general health; but at the same time, persons suffering from cervical spondylosis should not attempt for the same. And we should have a similar understanding for the shoulder stand: *Sarvangasana* and all others.

Dr. Prakash Chintamani Malshe needs congratulations and great deal of applause for this wonderful service which he has done by writing this beautiful work of him, which was the need of the hour. Starting from cells and muscles he has introduced the bird eye view and essential fundamental knowledge of all principal systems. Quotations from *Gheranda Sanhita* and some of the shlokas from *Bhagwadgita* bring his knowledge to the forefront. He has dwelved down to the earth- to the very root of Yoga in its original form.

Yoga is not the subject to teach or share with unwilling persons.Maharishi Patanjali has specifically said that it should be

shared everyday, systematically, scientifically, regularly, without fail and with interest.

May almighty Lord and Sadguru Sri Swami Sivanandaji Maharaj and all other yogis of the yore bless Dr.Prakash Malshe and his wonderful work to understand this essential science to know for practicing and teaching Yoga abhyas.

Prayers for wide publicity and popularity of this book.

Hari Om

Thy own self,
In the service of humanity,

Friday, 05-08-2005
Shravani Amavasya

(Swami Adhyatmananda)
President
Sivananda Ashram, Ahmedabad.

Sri Divya Jivan Sanskrutik Sangh
Sivananda Ashram, Sivananda Marg, Jodhpur Tekari, Ahmedabad-380 015.
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Introduction

Yogic practices have been in vogue for centuries in ancient India. Using them the practitioners of Yoga have lived well over 100 years and have maintained perfect health till the end.

In some exceptional instances they have even demonstrated to the world that voluntary, painless death is possible.

Today the world has awakened to the magic of yoga and the knowledge of yoga is spreading the world over. However, a question remains: Is there a way that a non-believer also can understand the basic physiological mechanisms involved in the yogic practices? Is it all metaphysical or just physical ?

Without going into the details of mysticism or even the theory of *shat-chakras* (6 plexuses) and keeping in mind the modern anatomy and physiology; is there any way to explain out the mechanisms which lead to the beneficial effects of Yoga?

The present work is an effort to answer these questions. I believe that whosoever practices the *asanas* and *pranayams* as described will derive benefit out of them.It is purely physical-nothing metaphysical.

In this book, there are some facts and revelations regarding the mechanism of action of the yogic practices that are being revealed for the first time to the world. Some of them are so obvious they almost need no experimental proof: it is surprising how they have escaped attention so far.

PROLOGUE

For centuries Yoga has been taught and practiced in India. It has been a part of religion and culture; and for some, a family tradition. Yoga has been defined by certain seers as the most scientific way to achieve the ultimate: what has been variously termed as enlightenment or God.

About the religious teachings we are supposed to accept them as they are taught; without questioning or reasoning. Here comes the place for faith. Having faith in God leads one to lead a religious life.

In its fullness Yoga has eight divisions (*Ashtang* Yoga), which comprise of *Yama, Niyama, Asana, Pranayama, Pratyahar, Dhyan, Dharana, Samadhi*. It is Samadhi- the ultimate state- which every follower of yoga craves for, or should crave for and should settle for nothing less, the Yoga gurus say.

A variety of achievements have been described in the scriptures known as *siddhis* like anima, laghima, mahima, etc; referring to the magical powers of getting smaller or larger and moving with speeds of wind and so on; but I have not seen anyone having achieved any of these. Who will like to make a lifetime effort to attempt to achive those siddhis which we haven't seen anyone achieving?

However, in today's changed world, which has more physical or material inclination than spiritual, yoga has found its value because we have seen that with regular practice of *asanas, mudras* and *pranayama* one can maintain good bodily health and can probably live longer. There are also certain bodily ailments that can be cured just with yogic practices without medicines. Diabetes mellitus, hypertension, hyperlipidemias, coronary artery disease and acid-peptic disease are few of them. Yogic practices have alleviated the sufferings of thousands of people suffering from arthritis, chronic bowel problems, asthma, bronchiectasis and psychiatric problems like depression. These have proved enough incentives to pursue yoga for us -the modern-day ambitious individuals.

We have selected the things that are useful to us, namely the physical aspect of yoga (Hatha-yoga) without feeling compelled to pursue the higher spiritual goals, i.e; the enlightenment.

It is here that the modern-day aspirant left behind the faith part and found something useful to prolong life: to increase the sensual enjoyment.

What, after all is the aim of life? What for is all the education, and what for the research and technology? We develop machines to reduce human effort but does it really improve the enjoyment in life? These are the few basic questions which have stirred the thinkers for ages. After all what do we want from life?

साहित्य वाचस्पति, साहित्य भूषण, संस्कृति रत्न
आचार्य डॉ० विष्णु दत्त राकेश
डी०लिट्०
पूर्व निदेशक : स्वामी श्रद्धानन्द अनुसन्धान प्रकाशन केन्द्र
पूर्व अध्यक्ष : मानविकी संकाय, हिन्दी एवं पत्रकारिता विभाग
गुरुकुल कांगड़ी विश्वविद्यालय, हरिद्वार

सदस्य : उत्तरांचल संस्कृति, साहित्य एवं कला परिषद
सदस्य : उत्तरांचल संस्कृत अकादमी
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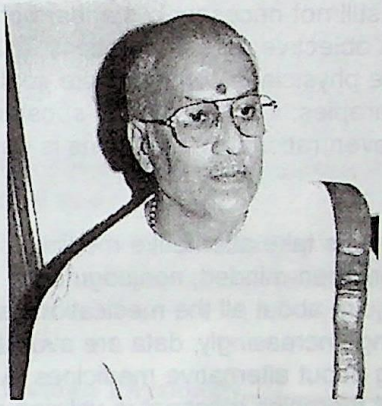

ॐ तच्चक्षुर्देवहितं पुरस्ताच्छुक्रमुच्चरत् । पश्येम शरदः शतम्।
जीवेम शरदः शतम्। शृणुयाम शरदः शतम् ।
प्रब्रवाम शरदः शतम्। अदीना स्याम शरदः शतम् ।
भूयश्च शरदः शतात् ।

◆◆◆

निर्मल ज्ञान स्वरूप देव हैं उज्ज्वल शुक्र सदृश द्युतिमान ।
जो निकाल अज्ञान तिमिर से करते जीवमात्र का त्राण ।

उन्हे खुली आंखों से देखूं कभी न हो ओझल यह सत्य ।
अनासक्त हो करूं सर्वदा परम लोकहितकारी कृत्य ।।

सौ वर्षों तक रहूँ देखता, बोलूं सुनूं सदा सौ वर्ष ।
जीवित रहूँ शरद सौ पाकर श्रेय-प्रेय मुद मंगल हर्ष ।।

जगन्नियन्ता अन्तर्यामी रहूँ सदा मै अचल अदीन ।
सौ शरदों का काल तैरकर बढे सदा आगे मन-मीन !

--आचार्य डॉ. विष्णुदत्त राकेश

आवास– 4, भगवन्तपुरम्, पो0 कनखल–249408, हरिद्वार (उत्तरांचल)
दूरभाष: 01334–244994 (आवास)

From Harrison's Textbook of Medicine, 15th Edition.....

The incorporation of science into medicine began only in the middle of the nineteenth century; *evidence-based medicine* is a recent term and still not necessarily standard practice. There is no such thing as objective care of a patient. There are many ways in which we physicians communicate goals and our own beliefs in our therapies; it is likely that a substantial proportion of benefit from even rational interventions is due to nonspecific effects.

Many of our patients take alternative medicines; physicians need to adopt an open-minded, nonjudgmental attitude toward the practice. Inquire about all the medications and supplements a patient is taking. Increasingly, data are available to help guide decision-making about alternative medicines. A thorough knowledge of all therapies a patient is utilizing may help explain unexpected findings and is an important component of a holistic approach to patient care.

Conventional medicine often casts a wary eye on therapies outside its boundaries, but it is incumbent upon physicians to evaluate evidence regarding alternative therapies with the same rigor with which we evaluate conventional therapies. Scientific evidence from controlled clinical trials supports specific applications of alternative medicine, and some therapies considered alternative today may well be incorporated into conventional medicine in the future.

CONTENTS

My word

In my childhood I did get some exposure to yoga in the family, especially when I was taught *Suryanamaskara* by my father. *Pranayama* was a part of the daily rituals of *Sandhya* that were taught to my elder brothers as a part of religious duty. I had known the '*Gayatri Mantra*'.However, about pranayama, all I had heard from my mother was that it was 'holding breath'. Father, being a student of medicine in the British *raj* days had probably come to see ayurveda as well as yoga as quackery as taught by the British.

Though the Bhagwadgeeta was taught and recited in our home by almost everyone, I never saw anyone practice what has been described in the 6th chapter as "*dhyana*".

I used to hear about yogis who had the capacity to fly in the air or walk on the surface of water. However, these things did not fascinate me. When boats are available, what is the point in achieving a skill to walk on water with a life-time effort? I thought. However, the thing that attracted me the most was that they lived long and healthy lives – Their prayers to be granted 100 years of life with intact vision, hearing, speech are part of our heritage!

ॐ तच्चक्षुर्देवहितं पुरस्तात्छुक्रमुच्चरत् । पश्येम शरदः शतम् । जीवेम शरदः शतम् । शृणुयाम शरदः शतम् । प्रबवाम शरदः शतम् । अदीना स्याम शरदः शतम् । भूयश्च शरदः शतात् ।

'May I live and see and hear and speak for 100 years! May I not be dependent on anyone for 100 years! And even for more than 100 years !!'

....And when it was finally the time to die, they undertook voluntary death: very peaceful and very painless!! In fact; painless death has been sought as a boon.

ॐ त्र्यम्बकं यजामहे सुगन्धिं पुष्टिवर्धनम् ।
उर्वारुकमिव बन्धनान्मृत्योर्मुक्षीय मामृतात् ॥

'We worship the three-eyed Lord Shiva who is fragrant and is giver of increased power. May we get freed of death as easily as a ripe fruit gets detached from its stalk.(painlessly).'

Yogis in ancient India have lived long- for 100 or 120 years, and have undertaken voluntary death also. This is clear in the legend of Gyandeva (Also known as sant Gyaneshwara) at Alandi in Maharashtra over 700 years back. More recently Sri Sri Paramhans Yoganand undertook what is known as *Sanjivani Samadhi* in 1952 at Los Angeles, California after addressing a gathering.It is this voluntary death that clearly separates the yogic practices from other forms of exercises.

As a schoolboy, I had read a pocket book on *Yog-asanas* by Sripad Damodar Satawlekar. On the back cover it was printed that with the power of *yog-asanas* the author had lived over 107 years. I became more curious about yoga in my early childhood, when once or twice I saw the roadside demonstrations of yogis going underground (literally!). They used to dig a ditch of about 5-feet-cubical shape; get into it while their *chelas* would cover the ditch with a wooden board, cover the board with mud, and wait and watch patiently till it was time to open the ditch. In one such show in my school a yogi had taken *Samadhi* for half an hour while in yet another one other yogi did it for 7 days! How he survived on such little air, and did he eat or drink anything and did he pass urine or stool at all ! I used to wonder; but there was no exposure except for that- I could not learn practical yoga in my childhood.

In 1982 I read Sri Yogendra's book *'Yog asanas simplified'* and for the first time I understood the difference between the effects of aerobic exercises, Suryanamaskara and yogasanas. Sri Yogendra has described how Suryanamaskara is more like the traditional aerobic exercises; and that yog asanas are different in that they do not cause increase in the heart rate, respiratory rate to that extent and bring about peace of mind. Coming to Hardwar in the year 1986, I was fortunate enough to be able to join one of the annual yoga training camps held under the auspices of the Divine life Society of Rishikesh and B.H.E.L.Haridwar under the able guidance of the revered Swami Adhyatmanandji. His style of teaching is such that anyone would be attracted to it. In that camp which lasted for just about 10 days, I learnt the preliminary *asanas*, re-learnt suryanamaskar and had my first introduction to internal cleansing processes: *neti, kunjal* and *shankha-prakashalana.* Such useful processes must be taught to medical students: I thought. They, with their knowledge of human physiology will be able to master these!

Later, at some time I had the opportunity to apply for a vacancy of a medical officer at Kaivalyadhama, (Lonavala). Although the idea of joining the institute did not materialize, I utilized the opportunity to purchase a few books published by the Kaivalyadhama society. It was through these books for the first time that I came across the original texts of *Gheranda Samhita Hathayoga Pradipika*, and later from other sources I procured *Shiva swarodaya*-all of them the works of the great sages. Somewhere deep inside, I felt re-united with my own ancestors: with whom my link had been severed through generations due to adverse times.

Recalling of the underground *Samadhi* undertaken by yogis in the school days, I used to wonder that although these demonstrations of their yogic strength were useful in generating curiosity, and might attract the masses, no modern man would be willing to acquire any such skill; primarily because it doesn't seem to be of any use to him in the present competitive world.

Much curiosity has been generated recently in the field of yoga, especially as a curative modality for many chronic ailments. Patients of diabetes, high blood pressure, bronchial asthma, various types of arthritis, and many other curable or incurable diseases-are getting attracted to yoga. While many of them do derive benefits by doing some *asanas* and *pranayama,* yoga is a science basically aimed at the healthy people. If more and more healthy persons take to practice of yoga, not only will they lead a long and healthy life, but the society as a whole will be free of several evils. Competition builds up stress in the minds of the competitors. Speed is the forerunner of accidents and over-ambition leads to wars. Meditation leads to cooling down of the mind, brings about internal gratification and obviates the need of the outward running about after physical wealth.

While regular practice of *asanas* and *pranayam* has been found to be useful in getting rid of many physical illnesses, one must understand that yoga is not only limited to *asanas* and *pranayam* but is a complete lifestyle in itself. Ancient yoga teachers have said something or the other regarding every aspect of life, be it personal, family or social life, and there is this definite way to think about life that yogis have recommended. For instance, there

is no place for rivalry or competition in yoga. This may go a little unpalatable to the modern youth because in each and every field one has to face exactly the opposite: competition and rivalry! No wonder then, that youth is not attracted to yoga- everyone thinks that it is a thing to do when you become old or a diabetic or a hypertensive or so on.

But I saw that the believers in yoga take the world differently. They think that there is enough provision of space, food and necessities for everyone and that all of us can live in peace and harmony. All others are seeking more and more wealth, and that is why those who did know the secret -that the ultimate contentment comes from inside ;not from material wealth- it did not reveal it to all. For similar reasons, yoga was not intended to be a science that can be taught to each and everyone.

Yoga in its original form is intended as a methodical science for the achievement of the superpower, the God. Yoga literally means 'union': the union of *jivatma* (The individual soul) with *Paramatma* (The super soul). There have been several branches of yoga, variously known as the *karmayoga, bhaktiyoga* and the like, *hatha yoga* is the one which deals with physical health and longevity. *Hatha* yoga or *ghatastha* yoga seems to be a perfect science in itself, leading to modifications in human physiology and psychology. Anyone who practices for sufficient length of time knows that not only does it strengthen the muscles, bones and ligaments; it has profound effect on the functioning of the internal organs (viscera). In the human body, the internal systems can be trained according to needs. For example, a person who keeps regular weekly fast can tolerate it better than a person who never fasts. Muscle growth and increase in strength is easily demonstrable after regular exercise. It is quite possible that by regular practice of certain techniques neuronal growth takes place in the CNS with formation of new inter-neuronal connections (Synapses) which may lead to establishment of perfect control of the conscious mind (Cerebrum) over one's subconscious and the autonomic nervous function.

लघुत्वमारोग्यमलोलुपत्वं वर्णप्रसादं स्वरसौष्ठवं च ।
गंधः शुभोमूत्रपुरीषमल्पं योगप्रवृत्ति प्रथमां वदन्ति ।।

श्वेताश्वतरोपनिषद्. 2/13

In the *Shwetashwatar Upanishad* the benefits of regular practice of yoga have been summarized as under:

'Lightness of the body, good health, lightness of complexion, melodiousness of voice, pleasant smell in the body, lesser quantities of urine and stool are the initial achievements of yoga.'

Pran and Apan: while *prana* is the name given to the movement of air in the upper part of body, *apan* in the lower part, we can understand *prana* as the air that enters the nasal passages, sinuses, the bronchial tree and the lung, and **also the air that enters the esophagus on swallowing and is belched out**. *Apana* is the air that is passed out as flatus. What can be the way by which *prana* or the air moving in the upper part of the body can be united with the air moving in the lower part of the body?

अहं वैश्वानरो भूत्वा प्राणिनां देहमाश्रितः ।
प्राणापान समायुक्तः पचाम्यन्नं चतुर्विधम् । भगवद्गीता 15/14

'I, taking the form of vaishvanar agni present in the bodies of all the creatures; by uniting pran with apana digest the four types of food'.

As a student of physiology I thought that no amount of air contained in the lungs can reach below the diaphragm and unite with *apana*. The only way the air can go down the diaphragm is through the esophagus (The food pipe). It is interesting to note that indeed, for achieving this the ancient yogis have devised several methods.

काकचञ्चूवदास्येन पिबेद्वायुं शनै शनै ।
चालयेदुदरं पश्चाद्वर्त्मना रेचयेच्छनै : । । घे01.15

वातसारं परं गोप्यं देहनिर्मलकारकं ।
सर्वरोगक्षयकरं देहानलविवर्धकम् । । घे0 1.16

काकीमुद्रां साधयित्वा पूरयेदुदरं मरुत् ।
धारयेदर्धयामं तु चालयेदधवर्त्मना । । घे0 1.21

Which means that one should drink in air (Suck it into the esophagus) by *Kaki–Mudra* and forcefully unite it with the *apan*. I can think of two ways in which this can be achieved: 1.Suck the air

in by *kaki-mudra* and force it down by holding breath in full inspiration with a closed glottis and creating positive pressure inside the thorax- to close the lower esophageal sphincter.2. By first filling the stomach with air by *kaki mudra* and then doing *sarvangasana* so that the air contained in the stomach can enter the duodenum.There are many benefits of these practices, we will deal with them elsdewhere in this book. Once the air reaches the duodenum it will naturally pass down the gut due to peristalsis.

***Uddiyan Bandh* :**

Create a hill station inside your lungs !!

It has been known for long that when one goes to stay at a hill station for a few weeks, one gains positive health and after coming back enjoys heightened levels of physical performance for several days to come. Effects of high altitude have been studied in great details by physiologists. It is now well known that at reduced pO_2 of the hill atmosphere the oxygen saturation of the blood is slightly lesser and that this lack of oxygen (Hypoxia) stimulates the respiratory centre. The respiration becomes fast and results in a slight alkalosis which provides stimulation to the bone marrow to produce more red cells.

Hatha yoga describes a process which has not been studied by the physiologists so far. It is known as the *Uddiyan Bandh*. One has to draw in the abdomen by forceful sucking-in effort against a closed glottis, (contracting the thoracic muscles of inspiration against a closed glottis.)

Thus this is reverse of what the modern scientists know as the Valsalva manouvre, which is forceful contraction of expiratory thoracic muscles against a closed glottis. In Valsalva manouvre the intrathoracic pressure rises several folds. The physiological effects have been well studied: they include reduction in the venous return to the heart.

On the other hand, *Uddiyan bandh*, when performed after a moderate inspiration, creates sub-atmospheric pressure inside the thorax. Thus the alveolar pressure is reduced, and so is the partial pressure of oxygen in the alveolar air (pO_2). It is thus capable of providing a hypoxic stimulation to the bone marrow much the same as one gets by staying at a hill station. By powerful contraction of the inspiratory muscle, pressure inside the thorax may be brought

about 70-100 mm below atmospheric; which is equivalent to climbing up to a height of 700-1100 meters of altitude !! Also, it is obvious that *uddiyan bandh* increases the venous return to the heart.

Sahita pranayama combines *uddiyan bandh* with a normal inspiration. Draw in air through the right nostril; close both the nostrils and then suck in the abdominal viscera. Hold in this position for up to 12-30 seconds and then gradually exhale through the left nostril. Repeat the process with the left nostril.

Fasting

Yoga *asana*s may tone up the abdominal muscles, strengthen the ligaments, help burning away the extra calories, facilitate movement of the gut, expel gases and build muscle power. But for those who want to reduce body weight, only *asana*s may not suffice and may have to be combined with fasting. In ancient India, religious fasts have been always undertaken, on one or two days in a week (say every Monday for lord Shiva and every Friday for *Santoshi Mata*) or once in a fortnight (Ekadashi). Different regimes may be prescribed according to one's needs and capacities. While fasting; one must not ask what to eat. However, free access to water is to be permitted.

The right and the left cerebral hemispheres: It is a well known fact that in our brain the two hemispheres perform slightly different functions. In a right handed person the left hemisphere is the 'dominant' one, now called the 'categorical'; and the right hemisphere is called the 'representational'. When the energy flow occurs in the left hemisphere, things like logical thinking, calculations, functions related with vocabulary, grammar and technical ideas come out easily. Learning of such things also becomes easy. On the other hand when the energy flow is relatively more in the non-dominant (right) hemisphere, things related with emotions, faiths and beliefs get the upper hand. Also, arts such as acting, music and poetry/*gazals* come easily. The non-dominant hemisphere has often been termed as the "Heart" by the poets and literary persons- *sahityakars*. It is obvious that the non-dominant hemisphere perceives, believes and feels several such things that are uncomprehensible by the left hemisphere which thinks logically. These things are variously called supernatural phenomena or just

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blind faiths *(Andha vishwas)*. For example a professor, a vice chancellor or a chief judicial magistrate may be seen to perform a ritual for which he knows there is no logical explanation.

In a discourse, when we hear a yogi or a swamiji, we hear with **faith**. Suppose the *swamiji* says by performing regular *dhyana* you will experience bliss; we hear it by our right hemisphere. At the same time, -somewhere inside; (probably in the left half of our brain) we do not believe it because there is no scientific explanation. Those of us who have heard and believed and followed all such instructions as 'sit facing the east while performing *pooja*'-instructions that have no valid explanation- right since our childhood; have these instructions recorded in our 'Parent'[1] which again is probably a part of the representational (right) hemisphere.

Most of us are in one or the other hemispheres at a given time. That is why often such phrases are heard: "My dear, don't be emotional. This is the time when you should think with your brain" Or at other times, "Why you are such a dry fellow? Don't you *feel* anything? Do you even have a heart?" What the person is trying to say is that why you always remain in the left hemisphere? Why can't you sometimes be in the right hemisphere like me?

The above phenomenon has been aptly summarized by the famous urdu poet *(shayar)* Nida Fazli:

दो और दो का जोड़ हमेशा चार कहाँ होता है ?
सोच समझ वालों को थोड़ी नादानी दे मौला !!

Translated by a physiologist this will read as "I can not stay always in my categorical hemisphere O god! To those who do stay there, grant some capability to turn the representational hemisphere on!"

In the whole human population is there anyone who always thinks in the factual or mathematical terms? That is; is there anyone who remains always in the categorical hemisphere? Probably only collective decisions are made by the categorical -left hemisphere. The courts go on factual findings and not by intuition or emotions. For example, a judge may have to sentence a culprit to death even if personally he knows the truth that thealleged person is innocent Later he may seek forgiveness in the court of God for having hanged

a person on the basis of available (?fabricated) evidence! When it has come to be discussed, I believe that that was the difference between the justice delivered by ancient kings such as King Vikramaditya and the present day courts. The ancient kings also took note of intuitions: clues other than acceptable to the categorical hemisphere. Recently; in a well known movie- when in the story an investigating officer learns that a certain crime was committed because of compassion or love and when he endorses the criminal file as 'closed'- he is listening to his representational (right) hemisphere and that is why it tickles your emotions.

Same is the case of scientists. They believe in scientific evidence; but that is only till when they are on the podium of a scientific conference. Once in their homes they get involved in rituals for which there is no scientific basis. That is the reason why when a doctor believes in yoga, he just believes in it. This belief is in his representational (right) hemisphere. The validations offered by yoga teachers such as "Sarvangasana massages the thyroid or nauli- *kriya* improves digestion and increases insulin secretion" do not satisfy the scientific, inquisitive mind (The categorical hemisphere) because it does not provide adequate explanation of the mechanism of action. It seemsthat out of respect towards the swamiji the data is somehow stored in the representational hemisphere. When doctors do write or deliver speech on Yoga, it shows clearly that there is a compartmentalization in their minds whereby Physiology lies in one compartment while Yoga lies in another and there is no connection between the two!

Even rare is a person who can use both the hemispheres at the same time or can facilitate flow of energy from one to the other hemisphere quickly at will.

This book is an attempt to scientifically validate the facts about yoga that so far we have just believed in; and provide clear idea what a particular *asana*, *mudra* or *pranayama* can do; and how.

In the modern days since our childhood we are not taught at any stage how to use our left or right hemisphere. We have been inhibiting and suppressing our emotional part or the right hemisphere. Our parents have been teaching us to do so. Even to date the parenthood goes like this! When a child cries, the parents

say "don't cry".Sometimes 'why you are crying like girls'*क्या लडकियों की तरह रो रहा है ।* If he enjoys an activity, several parents try to stop him. If he laughs heartily, parents and teachers do not approve the laughter either. They say "don't laugh". I have seen certain parents giving a bashing to their children just to prove that if you laugh too much you will end up crying. Regularly we have been taught to suppress our anger, and worse still, to laugh it out. In doing so we are not being authentic to ourselves. No doubt suppressing ones' emotions may be required in certain worldly situations, but it definitely puts some additional stress on the individual. Most of us have become full of suppressed emotions, and in some it may have resulted in certain psychiatric diseases.

For example; depression can be viewed as a situation where a person constantly lives in the right hemisphere. In him, it seems that the memory is also filled with unpleasant recordings which the person keeps retrieving and so everything appears unpleasant and meaningless. The whole life becomes meaningless and patients of depression often commit suicide. The factual information that everything is not so bad, and the thought that 'after all I have been bestowed with a healthy body, two eyes, two hands and feet, and there is enough of worldly wealth'-is contained in the left hemisphere; and there is a poor communication between the two hemispheres.

In our childhood we were also taught a few *shlokas* that are meant to remind oneself of the bestowments:

हस्तौ च पादौ नयने प्रसन्ने,
कर्णौ सुतीक्ष्णौ वदनं च कान्तम् ।
नासा सुरम्या मननाय चित्तम्
ईशेन दत्तं तदिदं समग्रम्। ।

क्रीडामि धावामि पठामि नित्यम्,
पश्यामि जिघ्रामि श्रुणोमि शुध्दम् ।
रात्रौ लभे चाथ सुखेन निद्राम् ।
ईशेन दत्तं तदिदं समग्रम्। ।

'Two hands, two feet, two bright eyes, two sharp ears and a smooth, radiant body; a fragrant breath and a sharp mind to think: All this has been given to me by the almighty'.

'I play and run and read everyday, I see, smell and hear accurately, I sleep at night a peaceful sleep: All this has been given to me by the almighty!'

Repetetion of these *shlokas* and remembering their meaning can help depressed individuals as the message contained therein may percolate down to the representational hemisphere or even the limbic system !

It has also been postulated that when the right hemisphere gets more blood supply the left nostril opens; and vice versa. Now there is some evidence coming to support this from positron emission tomography (PET) studies of the brain.

Pranayama is about regulation of the breathing through one, the other or both the nostrils. What is the significance of taking in breath through one nostril, and after holding it exhaling through the other nostril? How it can affect the communication between the two hemispheres? How can it make the mind calm and cool? These are the questions that need deeper study to be answered; and such studies must be undertaken using the most modern techniques like the positron emission tomography (PET).

It is worth noting that the ancient rishis have mentioned that when the air flows preferentially in the left nostril the understanding of a difficult subject becomes easy.

सूर्यप्रवाहे प्रवदन्ति विज्ञा ज्ञानं ह्यगम्यस्य तु निश्चयेन ।
श्वासेन युक्तस्य तु शीतरश्मेः प्रवाहकाले फलमन्यथा स्यात् ।।

शिवस्वरोदय,81

'The wise ones say that while breathing through the right nostril understanding of difficult subjects certainly becomes easy. When breathing through the left nostril, the effect is otherwise.'

Creating parasympathetic dominance

A modern cardiologist will very much like to get a parasympathetically dominated patient. It seems that this can be achieved with several practices which are taught in yoga.

Convergence of eyes: According to the scriptures, as a part of various asanas (*Siddhasana, Bhadrasana Padmasana, Matsyendra, Gorakshasana, and Yogasana*) and mudras (*Mahamudra, Shambhavi*) the eyes are to be focussed on the tip of the nose or between the eyebrows. As one can experience, in the beginning it puts a considerable stress on the brain.

Initially one may get a headache if prolonged effort is made, but with continued efforts it becomes easy; possibly some new tracts are formed from the cortex to the midbrain. In the longer run the parasympathetic tone may increase. Also, a smaller pupil size may sharpen the vision in presence of a refractive error.

Tratak: This is done by constantly gazing at a small, point-like object keeping the eyelids open and resisting any desire to wink. The eyes are kept open till tears flow down the eyes.

निमेषोन्मेषकं त्यक्त्वा सूक्ष्मलक्ष्यं निरीक्षयेत् ।
पतन्ति यावदश्रूणि त्राटकं प्रोच्यते बुधैः ।। घे0 1.52

Trataka may stimulate reflex tearing and in doing this there is stimulation of the ophthalmic division of the trigeminal nerve and the Edinger-westphal nucleus and this may in some way lead to parasympathetic activation.

Vagal stimulation is achieved by inducing vomiting by gagging. After having a full meal lot of water is swallowed and all of it is vomited out by putting two fingers in the throat. It is noteworthy that in present day psychiatric research electronic vagus stimulators are implanted as a part of treatment for depression.

Pelvic plexus may get stimulated by increasing downflow in the spinal neurons, as can happen in *Ashwini mudra,* which involves a constant practice of contraction and relaxation of the anus.

Morning walk or Yoga-asanas ?

Morning walk is an activity most recommended by cardiologists. It has been thus the teaching of modern cardiologists that a daily 45-minute walk will save you from heart attacks. Their argument is that in ancient times people did not have as many heart attacks as now, because they had to walk for long distances as part of their daily routine. They argue that a regular morning walk can cosume calories and ward off obesity, but to me it seems doubtful. Many will agree with me that walking alone does not reduce body-weight.In fact after a walk the appetite goes up and food consumption may indeed increase. One more problem with morning walk is that; one can not maintain absolute regularity. Sometimes it will rain, at other times it would be too dark or too cold; and sometimes just too hot and sweating. In any case, morning walk is tiring, can aggravate

pain in the knees and is not just equally enjoyable to all. Walking does not bring into action all muscle groups of the body, does not impose stretch on specific ligaments which could bring about postural corrections and there are no visceral advantages such as accrue from sarvangasana and various other asanas. Walking is aerobic exercise, there is no sustained muscle contraction that will increase the oxygen-debt capacity. Walking or any such exercise does not produce hypoxia at any time and the advantage of developing coronary collaterals and of bone-marrow stimulation is not obtainable. **For all these reasons I do not recommend morning or evening walk to anyone and rather recommend that they spend that one hour daily in praynayama and asanas.**

When yoga-asanas were first invented probably that was the age when man did not need to wander for food. It seems that yoga-asanas were performed, developed and taught by those who had plenty to eat and could afford to devote time to higher pursuits, like the search of God. Swatmaram, the author of *Hatha-Pradipika* also says that he has described hatha-yoga only as a stepping stone to Raja-yoga, which is *the* path leading to search of God. Thus I believe that those ancient rishis did not need to wander several hours for food.

I believe firmly that all the yoga-asanas were designed to be the convenient substitutes for having long walks. Unfortunately, for the modern cardiologists, there are lots of studies to show the beneficial effects of having long walks but very few to show the beneficial effects of performing regular yoga-asanas.

It can be concluded that:

1. We doctors should learn more of yoga- we are in a better position to understand the basic mechanisms. We can better explain them and advise them for the benefit of our patients.

2. More research has to be performed by our medical colleges with relation to physiological alterations produced by yoga. For this, physiology teachers and medical students have to acquire some knowledge of yoga

3. The present work is an attempt at this.

References.

1. Parent, Adult and Child are explanatory terms used by Thomas A. Harris, the author of '*I am O.K.-You are O.K.*'

I
Normal human physiology

Introduction

Physiology is the branch of science that deals with the study of normal functioning of the body under the various circumstances that come its way as part of life.

That means that we study the functions of the body in the so called "normal" environment, plus we study the various adaptive mechanisms associated with changes in climatic conditions, hot and cold, high altitudes, high pressure conditions, effects of starvation, effects of exercise etc.

Yoga is a centuries old storehouse of knowledge, practiced through thousands of years in ancient India and handed down from generation to generation of masters and disciples. Yoga is a complete way of living, of eating, thinking and doing everything, still, the physical side of which is called the *Hatha yoga* or *Ghatastha yoga* comprising of physical postures (asanas and mudras) and the internal cleansing procedures such as *vata-sara, vari-sara (shankh-prakshalana) neti* and *dhauti*, which directly alter the physiology of the practitioner *(sadhaka)*. In addition, control of breath (Pranayama) has been claimed to have vast physiological and psychological effects. It is surprising that so far the physiologists have turned a blind eye towards their study.

There are reasons for this, too. Number one, the knowledge of yoga was held as a great secret by the traditional practitioners, the yogis, who thought that if made public this knowledge loses its edge.

They themselves were able to greatly increase their longevity, physical strength and health, acquire control over mind and in a way were able to conquer death through those practices, but would not like to share the devote the whole life serving him would be given some knowledge. Secondly, for curious reasons it was made mandatory that anyone who desires to learn yoga will have to give up traveling, warming with fire (read cooking on fire) and especially the company of women as a preliminary to starting practice.

योगारम्भे वर्जयेच्च पथिस्त्रीवहिसेवनम् । घेरण्ड संहिता 5/26.

No need to say then, that the yogic practices were not meant for all. And they were not for women also.In the modern days, the doors of yogic knowledge have been opened to women as well as to householders(गृहस्थी).For practicing *asanas* and *pranayams*, observing these vows is no more a pre-requisite. From the far-off caves in the Himalayas, the knowledge of yoga has been brought to the common man through camps and tele-channels. Once this is available, physiologists should by now have started studying the alterations in organ functions associated with regular yoga practices. The practices are rock-solid real physical practices and must not be considered as supernatural phenomena that need to be believed in with faith. Just as a physical worker develops muscle hypertrophy even if he does not have faith in it, so also anyone who, performs yogic exercises- asanas, mudras and pranayams- (even without faith), is bound to get all the benefits in the form of physical and mental health. The yogic practices, (they are not exercises) are bound to exert their effects on the human body just as physical exercise does-but in a somewhat different way . While the physical exercise produces muscle growth, **yogasanas increase their capacity to contract anaerobically.**

For convenience of study the subject physiology is divided into various chapters like the cardio-vascular system, respiratory system etc. While modern physiology depends upon animal experiments for a large proportion of knowledge (Experimental physiology); in yoga, it is obviously not possible to study the effect of asanas and pranayama in animals. The purpose of this book is not to teach normal human physiology, but it seems pertinent to discuss the relevant portions of human physiology before going on to describe the effects of the various yoga practices on them.

Muscle Physiology

Isotonic exercises lead to muscle hypertrophy. There is increase in the size of muscle fibre and the bulk of muscles increases.

However, most yoga asanas are static postures, some of which require muscle contractions which are of isometric nature.

The effects of continued isometric exercise training probably have not been studied so well. There is no great increase in the bulk of muscles, but, as one can observe in a trained yogi; the capacity to sustained isometric contraction increases.

Circulation through skeletal muscle:

Blood flow in the resting muscle is low. When a muscle contracts, it compresses the blood vessels contained in it. If it contracts maximally or even 70% of the maximum, the blood flow is completely stopped. Between contractions the blood flow is greatly increased- to about 30-folds. Blood flow in resting muscles doubles after sympathectomy (cutting away of sympathetic nerves). Local factors such as a fall in pO_2, rise in pCO_2, accumulation of K+ and other metabolites such as lactic acid cause vasodilatation in the muscle. Fluid transudation into the extracellular space is increased and this is taken away by the lymphatics. The lymph flow thus greatly increases. The oxygen consumption of an exercising muscle can increase up to 100 folds. This is supplied by an increase in the blood flow as well as increased arterio-venous oxygen difference.

The oxygen debt mechanism

The muscle contraction requires energy which is derived from oxidation of glucose. Up to an extent the muscle can manage without putting demand on the circulation. However, with continued muscle activity the blood circulation to the muscle increases several folds because of local vasodilator factors. Three mechanisms operate which can sustain muscle activity even in absence of increase in blood supply.

1. The Phosphorylcreatine is used to synthesise ATP.
2. Some ATP synthesis is asccomplished by anaerobic oxidation of glucose to pyruvic acid which gets converted to lactate.
3. Some oxygen stored in myoglobin is utilized.

In a short run of say 100 meters that takes about 12 seconds, about 85% energy is derived anaerobically.It is worth noting that in order to achieve better efficiency in the day-to-day activity which involves running up stairs of about 10-20 feet it is beneficial to have more capacity to oxygen debt. Yoga *asanas* can bring about precisely these changes. However, presently we only know that

continued practice of yoga *asanas* increases the capacity to sustain the *asanas* for longer duration of about say, beyond 90 seconds. Most likely this increased capacity of a muscle results from increased concentration of myoglobin, of creatine and ATP.

Bone Physiology

Bones have outer part called the compact bone and the inner part called the trabecular bone. Compact bone has low surface to volume ratio, and there are very few cells: the osteocytes. They receive nutrients via the Haversian canals which contain blood vessels. Around each Haversian canal collagen is arranged in concentric layers forming cylinders called the Haversian system.

Because of the high calcium and phosphorus content the bone provides the rigidity required for locomotion and protects vital organs.

Old bone is constantly being resorbed and new bone formed, in this way it is also able to respond to the stresses and strains that are put on it. The bone trabeculi align themselves in the direction of stress

To put stress on different bones of the body is the aim of exercise. When one performs different yoga asanas; one is putting stress on different bones. For example, in *tadasana* when we stand with our heels elevated, we are putting stress on the small bones of the toes-the metatarsals. In *tikonasana* the stress is on the neck of femur. In this way different asanas contribute to maintaining the strength of different bones. How much time of stress is just enough to maintain the normal bone strength remains to be studied, however, much depends upon the available time and most of us will be able to devote about one hour for Yoga asanas in which every asana can be performed for about 1-2 minutes. One may wonder what quantum of growth stimulus is delivered to the bones in this short a time,but we must understand that any quantum is better than having no stimulus at all.

Osteoporosis is an important problem in which there is loss of bone-mass-density. It is related to age, physical inactivity and withdrawal of hormonal support (as after menopause).Osteoporosis weakens the bones and leads to fractures. A fracture of neck of femur needs to be treated with surgical replacement .

Physiology of the nose

The nose is very important component of the respiratory system.The nasal conchae warm up the incoming air, make it moist, filter it by the hair present in the nose and by trapping of dust particles in the mucus.The capillaries in the nasal circulation drain in sinusoidal structures which are endowed with smoth muscle in their walls and are capable of contracting. When they fill up with blood; the nasal cavity gets blocked. Sympathetic nervous stimulation constricts them. For this reason sympathomimetic drugs are used as nasal decongestants. The nasal mucosa is very sensitive to air temperature. Cold air entering the nose produces immediate reaction in the form of congestion and mucus secretion.This is known as vasomotor rhinitis.For someone, it can spoil a fine morning.However, we do not know whether there is any difference in the right and the left nostril in this respect.

The nasal cycle: 80% of normal individuals experience a cyclic change in the status of congestion in one or the other nostril. The cycle length is said to vary from 2-7 hours. It is also clear that if one lies in a decubitus position then the nostril which lies upper gets opened while the lower one gets congested. Ancient scriptures in yoga particularly swar shastra of which *Shiva-swarodaya* is a representational work advise everyone to allow cold air in the right nostril. For this reason, one should lie on the left lateral decubitus for just 5 minutes before getting up from the bed and one should leave the bed only when the right nostril opens up. **My own experience is that since when I started following this simple technique about twelve years back I did not have to sacrifice a single morning because of a blocked or a running nose.**

There are many way available to correct a running or congested nose. In our childhood we used to take in hot air from a lantern which we used to light for reading. This would open up a blocked nose, but the congestion returns as soon as cold air rushes in. Presently I will recommend one to use *sheetali pranayama* which involves taking in air through the mouth rolling the tongue into a tube-like structure; and after the inhaled air gets heated upto body temperature in the thorax; exhale it slowly through both the nostrils.

Another way to get relief in blocked nose is to use the open nostril to fill in the air and after heating in the lungs exhaling it through the closed nostril.

II

The Morning Prayer

ॐ

ॐ सह नाववतु । सह नौ भुनक्तु । सहवीर्यं करवावहै । तेजस्विनावधीतमस्तु । मा विद्विषावहै । ॐ शांतिः शांतिः शांतिः ।

'You and I (The guru and the disciple) shall eat together, shall rest together, shall acquire strength together. My your and my talent grow together, Let us not be jealous of each other. Peace everywhere! Peace everywhere!! Peace everywhere!!'

ॐ तच्चक्षुर्देवहितं पुरस्तात्छुक्रमुच्चरत् । पश्येम शरदः शतम्। जीवेम शरदः शतम्। शृणुयाम शरदः शतम् । प्रब्रवाम शरदः शतम्। अदीना स्याम शरदः शतम् । भूयश्च शरदः शतात् ।

'I see very clearly like the morning star before my eyes: May I see for 100 years, may I hear for 100 years, may I speak for 100 years, may I not be dependant upon anyone for 100 years, and even for more than 100 years.'

ॐ सर्वे भवन्तु सुखिन : ।
सर्वे सन्तु निरामयाः ।
सर्वे भद्राणि पश्यन्तु ।
मा कश्चित् दुः खभाग्भवेत् ।

'May everybody be happy, may everybody be free of disease, may everybody see to it that nobody suffers from pain and sorrow.'

ॐ असतो मा सद्गमय ।
तमसो मा ज्योतिर्गमय ।
मृत्योर्मा अमृतं गमय ।

'May truth go where there is light go where there is darkness, may immortality go where there is death.'

ॐ पूर्णमदः । पूर्णमिदं । पूर्णात् पूर्णमुदच्यते ।
पूर्णस्य पूर्णमादाय पूर्णमेवावशिष्यते ।

That (Almighty God) is complete, this world that derives from him is also complete, when complete is subtracted from complete, complete remains

ॐ शांतिः शांतिः शांतिः ।

Peace everywhere !Peace everywhere !Peace everywhere !

III
The preliminaries

Let us now see what the scriptures of Yoga have to say about how to begin with the practice of Yoga, especially, hatha-yoga.

1.Diet

नात्यनश्नतस्तु योगोऽस्ति न चैकान्तमनश्नतः ।
न चाति स्वप्नशीलस्य जाग्रतो नैव चार्जुन ।। गीता 6/16
युक्ताहारविहारस्य युक्तचेष्टस्य कर्मसु ।
युक्तस्वप्नावबोधस्य योगो भवति दुःखहा ।। गीता 6/17

O Arjuna ! Neither he who eats too much nor he who eats too little succeeds in yoga. Neither the one who sleeps too much nor the one who keeps awake!

Only to the one who takes appropriate quantity of food, does appropriate amount of effort and takes appropriate amount of sleep the yoga becomes destroyer of all sorrows. (Geeta 6/16-17)

मिताहारं विना यस्तु योगारम्भं समाचरेत् ।
नानारोगो भवेत्तस्य किंचिद्योगो न सिध्यति ।। घे.5/16

'He who begins the practice of Yoga without controlling his diet suffers from many diseases and does not make progress in Yoga.'

शुद्धं सुमधुरं स्निग्धमुदरार्ध विवर्जितम् ।
भुज्यते सुरसंप्रीत्या मिताहारं इमं विदुः ।। घे. 5/21

'Controlled diet is one which is pure, sweet, lubricated, and fills only half of the stomach and which is palatable and is eaten to please the God (in oneself).'

अन्नेन पूरयेदर्धं तोयेन तु तृतीयकम् ।
उदरस्य तुरीयांशं संरक्षेद्वायुचारणे ।। घे.5/22

'One should fill half the stomach with food, one quarter with water and the fourth quarter should be reserved for the movement of air.'

IV
The *Asanas*

In Patanjali's Yoga-dasrshan an asana is defined as...

स्थिरसुखमासनम् ।योगदर्शन 2/46,

'Any posture that can be maitained with comfort is an asana.'

Later, by other sages more stress must have been laid on different asanas for improvement of bodily health.

The scriptures have said 'There can be as many *asanas* as there are species of animals...

आसनानि समस्तानि यावन्तो जीवजन्तवः ।
चतुरशीति लक्षाणि शिवेन कथितानि च ।घे. 1/2

...eighty four lakhs of them have been mentioned by lord Shiva.'

For this reason, it can be stated that **any posture that you can imagine is an asana.** They may have been named and re-named and the older names forgotten down the centuries. For this reason, there is some difference in the naming of some asanas according to different authors. We will not enter into any such controversy. There is left no scope to device new asanas. For a common man, performing a few asanas should suffice. There is enough freedom for everyone to choose a few asanas which one finds particularly useful and possible to perform. As a medical specialist, I can advise in this regard that the selected asanas should include one for each of the different group of muscles e.g. flexor of arm or extensors of thighs etc.

As seen by a doctor, yoga asanas can be divided into two catagories: One- requiring a sustained muscle contraction. The examples are Tikonasana, Matsyasana, Shalabhasana and Dhanurasana. Due to the fact that they require sustained muscle contraction, they are anaerobic exercises. When one starts a practice of yoga, probably maintaining such a posture in one asana is difficult beyond about 30 seconds. When one sees the difficulty in staying in an asana for long, one wonders about the definition of asana given above! But with regular practice of a few weeks to months one is

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able to perform an asana for much longer: 90 seconds or more; and one would be comfortable while performing that asana. Such an asana is said to have been achieved. (साधना)-i.e.one has achieved perfection in that asana. By regular practice of asanas, the muscles build their oxygen stores and the capacity for oxygen debt increases. Such trained muscled do not put a demand on the heart with each trivial activity of the day-to-day life.The second type of asanas do not require a sustained musculat effort. Such asanas are good for pursuing meditation (Dhyana) This catagory includes Padmasana, Siddhasana, etc, all sitting postures.

Asanas have both musculoskeletal and visceral beneficial effects. Some of the effects are quite obvious; you can see yourself that in a particular asana the stress is borne by a certain group of muscles.

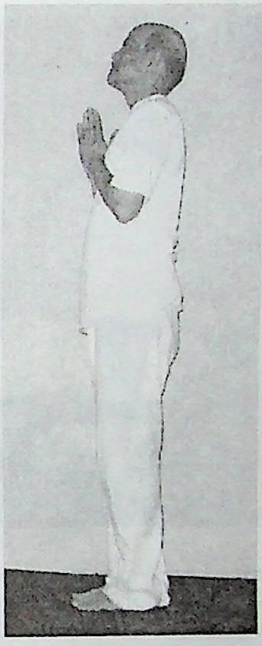
For any movement occurring in the body, say for example we take the case of flexion and extension at the knee, all the fibres of the extensor muscle do not contract at the same time. Since the fibres take origin from different locations- called the 'head' or origin of a muscle-some from one point of a bone , some from anotherand still others from a different bone, it can be understood that different fibres are in advantageous position at different degrees of flexion or extension. Some muscle fibres contract when the joint is near full extension while some different fibres contract when it is near full flexion. In order to give anaerobic exercise to each and every group of muscle fibres, different asanas have to be selected in which different degrees of flexion are maintained

Since while performing the asanas the daily availability of time is an important restraint, we have selected the following asanas for followers at our centre and recommend the same order while performing them

Surya namaskara

Suryanamaskara are not included in yoga asanas. Their effect is different, it is more like the aerobic axercises. Suryanamaskaras are good for the beginner whose body lacks flexibility or the one who is accustomed to performing aerobic exercises. In such cases we recommend that Suryanamaskaras be performed quite slowly, each step should be given adequate time so as one cycle of 12 steps covers about 1 minute, and the speed should be brought down further from day to day and week to week.

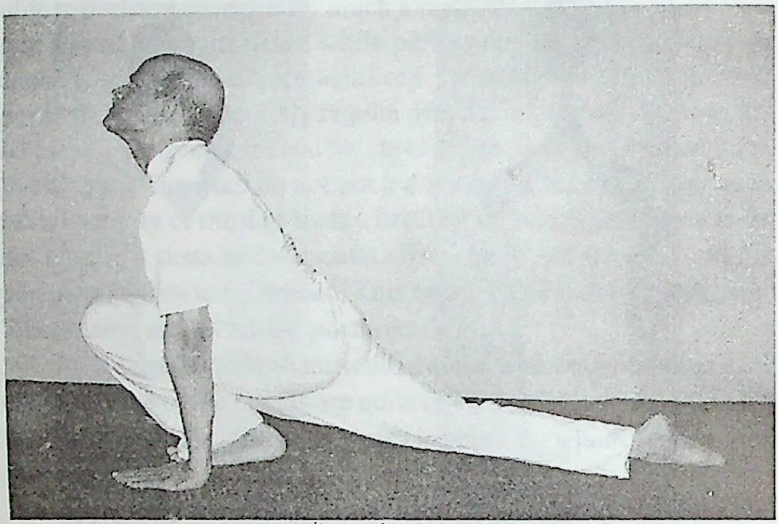
ॐ मित्राय नमः ।



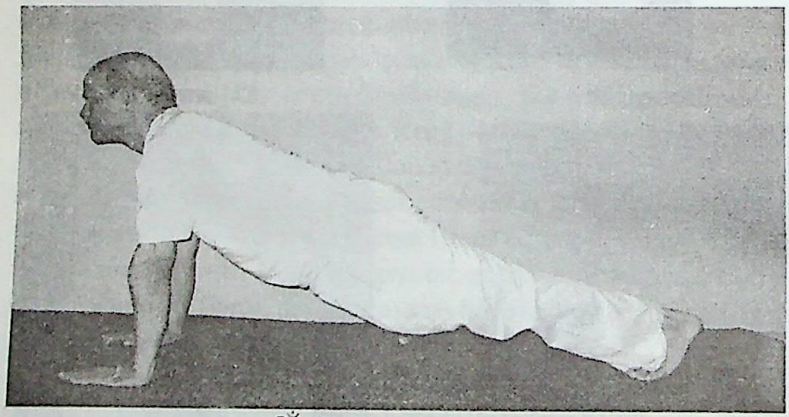
ॐ मित्राय नमः ।

ॐ रवये नमः ।

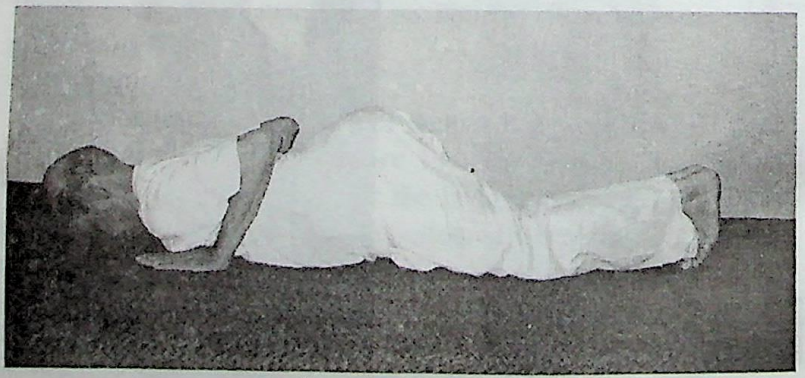
ॐ सूर्याय नमः ।



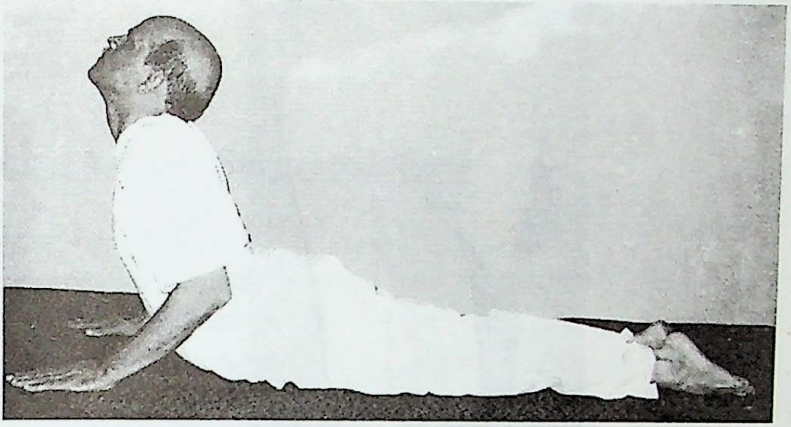
ॐ भानवे नमः ।



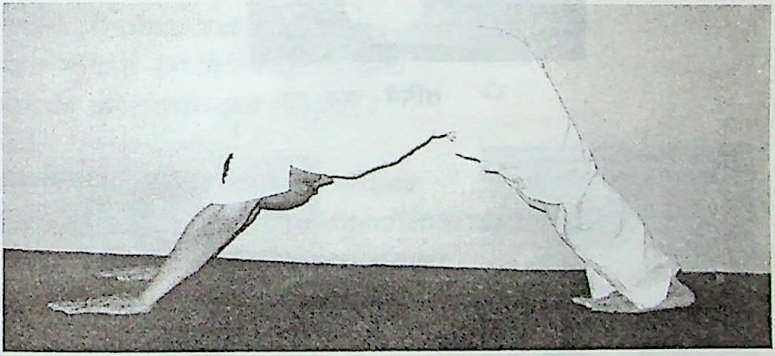
ॐ खगाय नमः ।



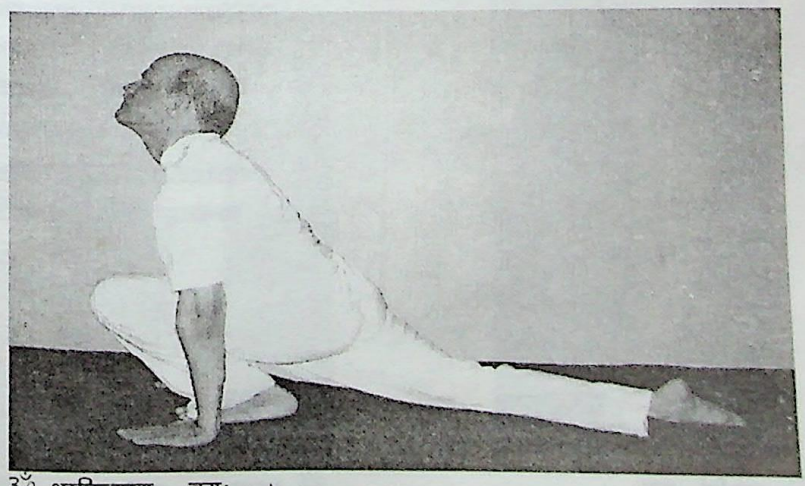
ॐ पूष्णे नमः ।



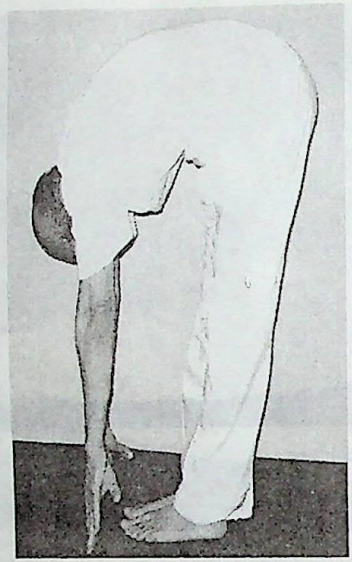
ॐ हिरण्यगर्भाय नमः ।



ॐ मरीचये नमः ।

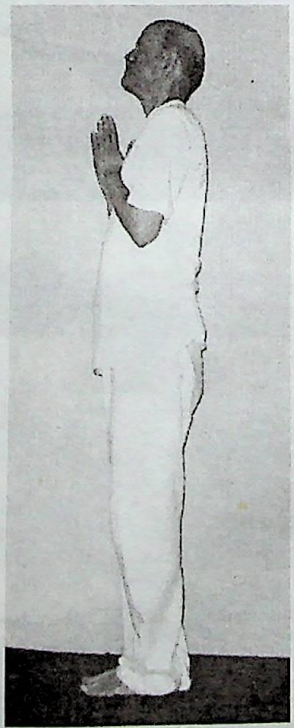


ॐ आदित्याय नमः ।



ॐ सवित्रे नमः ।

ॐ अर्काय नमः ।



ॐ भास्कराय नमो नमः ।

आसन Asanas: Suggested order

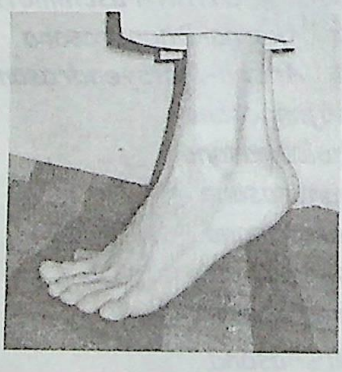
ताडासन Tadasana
तिकोनासन Tikonasana
वीरासन Veerasana
सर्वांगासन Sarvangasana
उष्ट्रासन Ushtrasana
वज्रासन Vajrasana
मत्स्यासन Matsyasana (TypeII)
पद्मासन Padmasana
उत्थित पद्मासन Utthit-Padmasana
मत्स्यासन Matsyasana (TypeI)
हलासन Halasana
पश्चिमोत्तानासन Paschimottanasana
उत्थित पश्चिमोत्तानासन Utthit-Paschimottanasana
आकर्ण-धनुरासन Akarna-Dhanurasana
अर्द्ध-मत्स्येन्द्रासन Ardha-Matsyendrasana
भुजंगासन Bhujangasana
शलभासन Shalabhasana
धनुरासन Dhanurasana
मकरासन Makarasana
चक्रासन Chakrasana
मयूरासन Mayurasana
शीर्षासन Shirshasana.
शवासन Shavasana

ताडासन Tadasana

Procedure: Stand erect with both the upper limbs elevated well above the head. Now elevate the heels. Stay in this posture for about 2 minutes or more. (See photo)

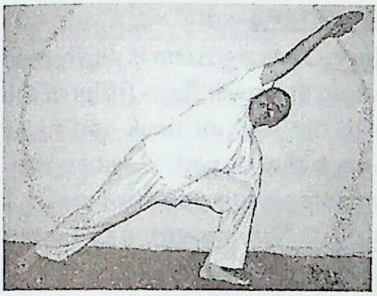
Advantages: Tadasana strengthens the small bones of the feet, called the metatarsals. (It is interesting to note that about 20% of all fractures occurring after 45 years of age are the fractures of metatarsals, often multiple fractures.)

It imposes anaerobic load over the calf muscles, namely the gastrocnemius and the soleus. One can practice *tadasana* in various positions from half to full plantar flexion.

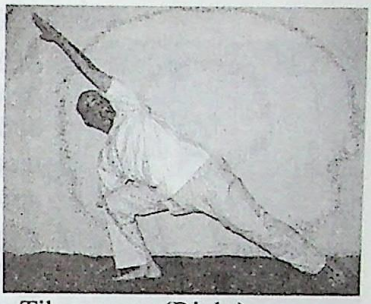


तिकोनासन *Tikonasana*

Procedure: Stand with the feet 2-3ft. apart. Now turning to left side bend the left knee so as to touch the ground with the left fingertips. One can put half weight on all the five fingertips. The right margin of the whole body forms a straight line while the right arm, forearm and hand is straight above the head in the same straight line. *Tikonasana* has to be repeated on the right side for the same duration.



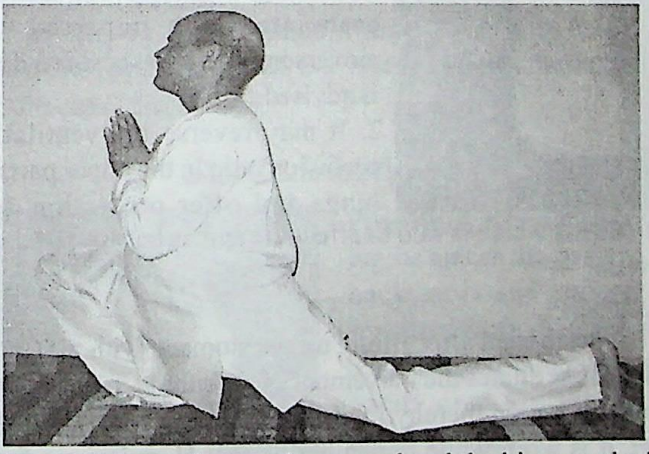
Tikonasana (left)



Tikonasana (Right)

Advantages: Tikonasana builds up the anaerobic capacity of the quadriceps muscles. The neck of femur also becomes strong (It is noteworthy that in old age fracture of neck of femur is the most debilitating condition. It requires immediate surgery.) By putting some weight on the fingertips the metacarpal bones become stronger.

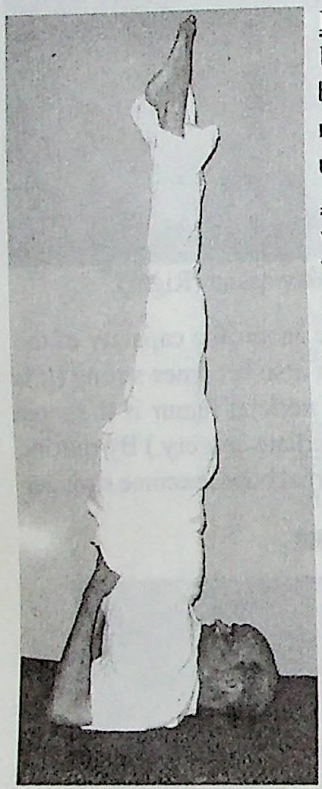
वीरासन Veerasana



Procedure: With one foot on the ground and the hip near the heel the other foot is stretched backwards, with the other knee resting on the ground. Stay with folded hands in this posture for 90 seconds. Repeat with the other foot forwards for equal time.

Advantages: Veerasana puts stretch on the ligaments of the hip joint and the extension which is often inadequate; becomes 180°. This is thus very helpful in cases of spondylolisthesis. However, such patients must reduce their weight to normal and there should be no pot belly.

सर्वांगासन Sarvangasana



Procedure: *Sarvangasana* is performed by elevating the lower four- fifths of the body with the back of neck and head resting upon the ground. One can stay up to 5 minutes in this posture. (see fig.)

Advantages: *Sarvangasana* has more visceral than musculoskeletal effects. The following beneficial effects need almost no evidence:

Respiratory effects

1. It facilitates drainage of secretions in the tracheo-bronchial tree, in cases of impaired muco-ciliary elevator.

Chronic bronchitis, bronchiectasis and lung abscess are disorders associated with impaired ciliary movements. In these, postural drainage is advised.

2. It may reverse the ventilation to perfusion ratio in the upper parts of the lungs and offer protection against tuberculosis which is said to affect the apices because of the more V:P ratio.

GIT effects:

1.If performed after filling up the stomach with air (by Kaki-Mudra) it facilitates the movement of air bubble in the stomach to the pyloric region thereby inhibiting the organisms *Helicobactor pylori.* It is worthwhile remembering that H. pylori are found in over 20% of the population.H.Pylori are the organisms responsible for non-ulcer dyspepsia, peptic ulcers,and in the longer run, chronic atrophic gastritis and gastric cancer. No wonder the consumption of acid-inhibiting drugs is of the tune of 225 crores.

2. The air moves down the duodenum, from where it reaches the colon; thereby inhibiting anaerobic organisms including *Entamoeba histolytica.* The air is ultimately passed down as flatus. If the anal sphincter is let loose, it may facilitate air-entry into the rectum through the anus with a similar anti-amoebic effect.

Genito-urinary effects:

In women,

1. It may facilitate air entry into the vagina thereby inhibiting anaerobic infections there.

2. It may help repose the uterus where it is starting to move down proceeding to prolapse.

Circulatory effects:

1. It may facilitate drainage of blood in leg veins. Some varicosities which may be starting to develop may get corrected.

2. It may facilitate drainage in the lymphatics of the lower limbs.

3. It may facilitate inflow of lymph from the thoracic duct into the thorax.

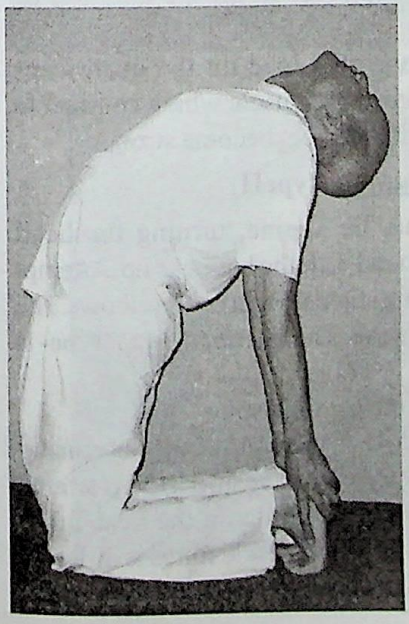
Others:

1. It may put a certain weight over the thoraco-abdominal diaphragm and give it some exercise.

Possible harmful effects:

1. Where the leg veins contain a loose blood clot it may get dislodged, move up the venous tree and may block the circulation in the pulmonary circulation.

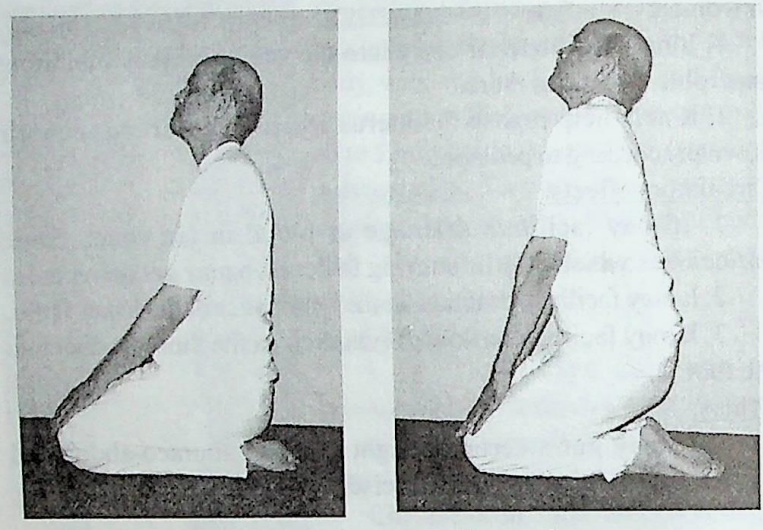
उष्ट्रासन *Ushtrasana:*



Procedure: Kneeling and keeping the toes on the ground, bend backwards and support the weight of the body over the extended upperlimbs keeping the hands over the heels; with thumbs inside and fingers outside.

Advantages: Ushtrasana strenghthens the metatarsal bones. It puts anaerobic load on the glutei, the paraspinal muscles and the quadriceps muscles in their semi-flexed position. Neck extension is good for maintaining flexibility of the neck

वज्रासन Vajrasana



जङ्घाभ्यां वज्रवत्कृत्वा गुदपार्श्वे पदावुभौ ।
वज्रासनं भवेदेतद्योगिनां सिद्धिदायकम् ।। घे.2/12.

Procedure: Sit keeping the two feet on either side of the anus and resting the hips on the heels. Then make the thighs tight (By contracting the quadriceps muscles so as to lift the buttocks by about 1-2 cms.)

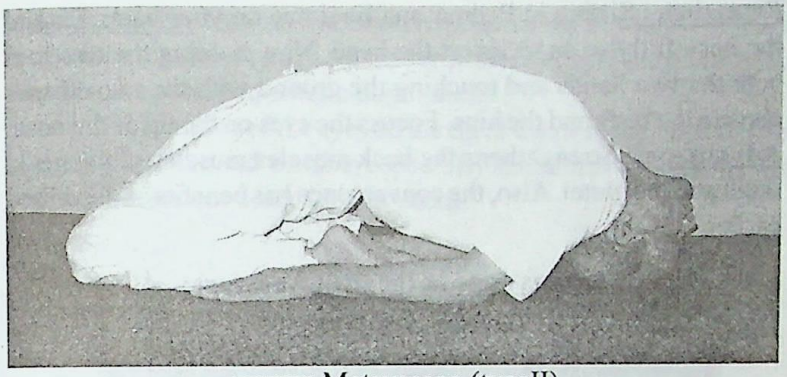
Advantages: Vajrasana puts anaerobic load on the quadriceps muscles: Those fibres of the quadriceps muscle which contract in the almost-fully flexed position of the knee; become stronger.

मत्स्यासन *Matsyasana* (typeII)

Procedure: Sitting in vajrasana, lie supine, turning the head backwards and resting it on the ground. Lift the buttocks up. Attempt to lift the head off the ground putting slight weight on the elbows. The eyes are focussed at the tip of the nose. This is *Matsyasana* type- II

Advantages:

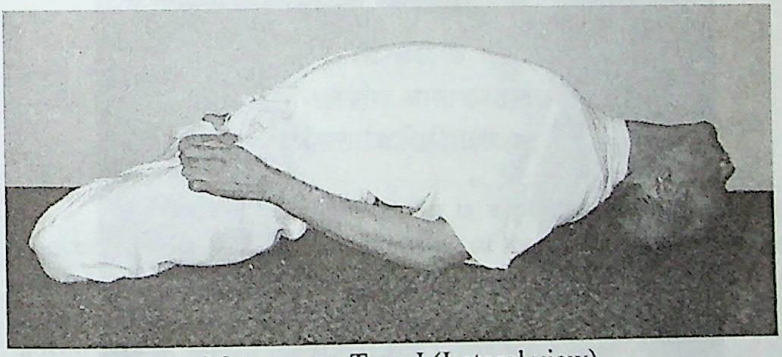
1. Improves flexibility of the cervical spine.
2. It puts stress on the quadriceps muscles thereby increasing their anaerobic capacity in the fully stretched position. (This stretch affects a different set of fibres which contract in the near-fully-flexed position of the knee joint. This set of muscle fibres is different from the earlier described tikonasana)



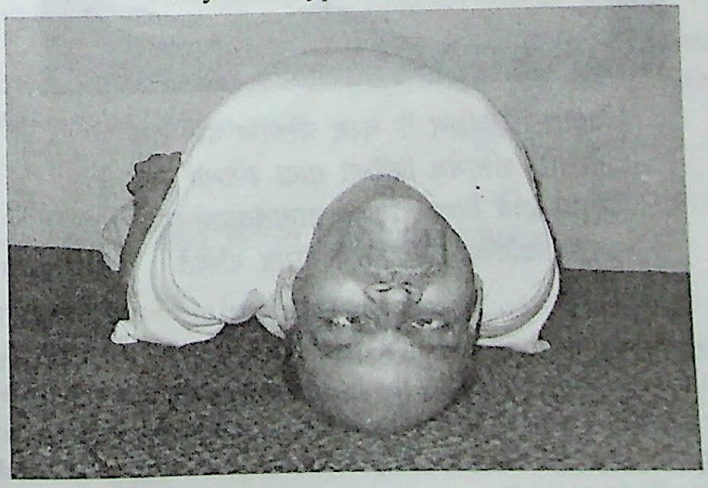
मत्स्यासन Matsyasana (typeII)

मत्स्यासन Matsyasana Type I

It is performed while sitting in Padmasana (See next).



Matsyasana Type I (Lateral view)

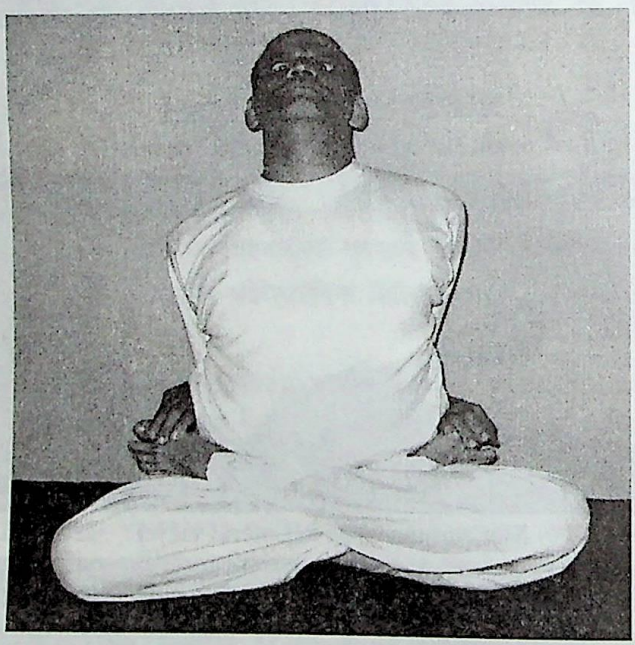


Matsyasana Type I- showing convergence of eyes

Procedure: Sitting in Padmasana lie down on your back. Extend the neck fully so as to invert the head .Now holding the two toes with the two hands and touching the ground with the two elbows elevate the back and the hips. Focuss the eyes on the tip of the nose.
Advantages: Strenghthens the back muscles,muscles of the neck, thigh and the glutei. Also, the convergence has benefits as described earlier.

Asanas done in the sitting posture:

पद्मासन Padmasana:



वामोरुपरि दक्षिणं हि चरणं संस्थाप्य वामं तथा
दक्षोरुपरि, पश्चिमेन विधिना धृत्वा कराभ्यां दृढम् ।
अंगुष्ठौ हृदये निधाय चिबुकं नासाग्रमवलोकयेत् ।
एतद्व्याधिविकारनाशनकरं पद्मासनं प्रोच्यते । । घेरंड संहिता 2/8

Baddha-Padmasana:

Procedure: Placing the right foot on the left thigh and the left foot on the right thigh, crossing the hands behind the back to hold the two big toes, placing the chin on the chest, one should focus the gaze on the tip of the nose.(If you do not hold the toes it is called Mukta Padmasana.)

Advantages: This *padmasana* is said to be the destroyer of all the diseases.It is mainly to be used for prolonged convergence which can create parasympathetic dominance.

Focussing of the eyes on the tip of the nose has been advised in other *asanas* and mudras especially shambhavi mudra; as well which we are not describing in detail.

Bhadrasana

गुल्फौ च वृषणस्याधोव्युत्क्रमेण समाहितः ।
पादांगुष्ठौ कराभ्यां च धृत्वा वै पृष्ठदेशतः ।
जालन्धरं समासाद्य नासाग्रमवलोकयेत् ।
भद्रासनं भवेदेतत्सर्वव्याधिविनाशनम् ।। घे.2/10

Simhasana

गुल्फौ च वृषणस्याधोव्युत्क्रमेणोर्ध्वतां गतौ ।
चितियुग्मं भूमिसंस्थं करौ च जानुनोपरि ।
व्यात्तवक्त्रो जलन्धेण नासाग्रमवलोकयेत् ।
सिंहासनं भवेदेतत्सर्वव्याधिविनाशनम् ।। घे.2/15

Advantages: *Padmasana* is a posture for practicing concentration (*dhyana*); the focusing of the eyes on the tip of the nose leads to parasympathetic activation as the convergence is associated with miosis which is parasympathetically mediated.It is a pity that in earlier centuries the yogis have been denounced as 'nose-tip-gazers'.

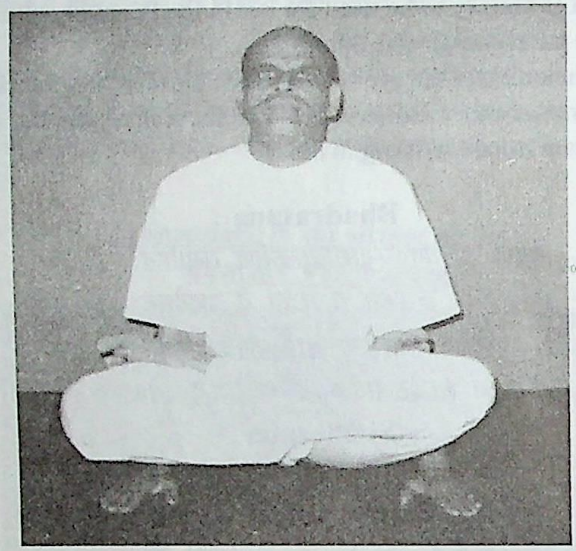
Padmasana is one of the few basic *asanas* that further lead to more *asanas*. For example, one can perform the *utthit-padmasana* which is as under.

उत्थित पद्मासन *Utthit- padmasana.*

Procedure: Sitting in baddha padmasana, elevete the body bearing the whole weight on the two upper limbs.

Advantages: In *utthit-padmasana* the whole weight of the body is borne over the extended upperlimbs. It strengthens the arm and forearm bones and extensor muscles. The rectus abdominis muscles are contracted and are under anaerobic load.

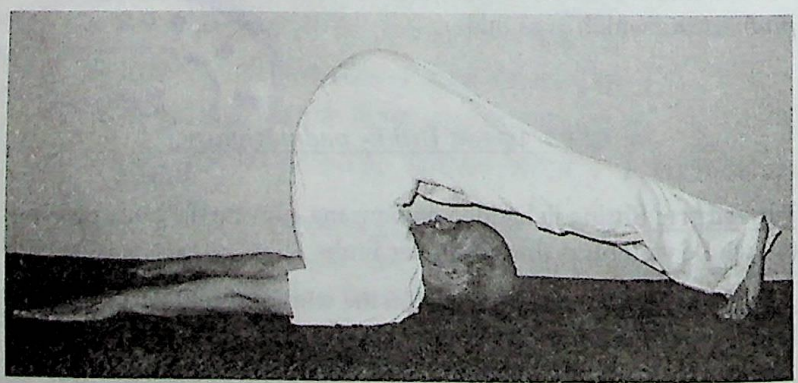
उत्थित पद्मासन *Utthit- padmasana.....*



हलासन Halasana

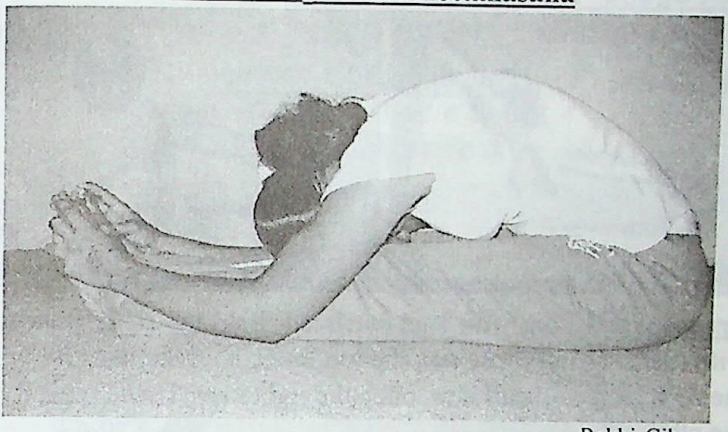
Procedure: Lying supine, elevate the lower half of the body putting the weight on the arms and hands just like in sarvangasana. Now turn the legs backwards and slowly bring them down to touch the ground.

Advantages: *Halasana* stretches the dorsal spinal ligaments and improves spinal flexibility. The thoraco-abdominal portion is inverted and in this way all the pulmonary and gastric advantages described for *sarvangasana* are also obtained in *halasana*.



हलासन Halasana

पश्चिमोत्तानासन् Pashchimottanasana



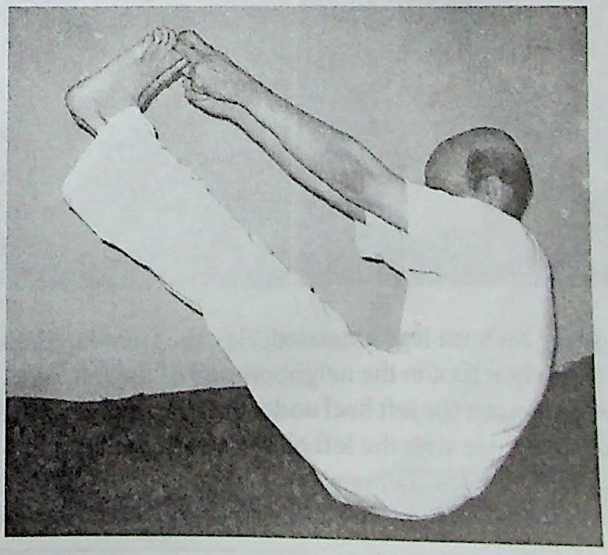
Rakhi Gihara

प्रसार्य पादौ भुवि दण्डरूपौ विन्यस्तभालं चितियुग्ममध्ये ।
यत्नेन पादौ च धृतौ कराभ्यां तत्पश्चिमोत्तानमिहासनं स्यात् ।।घे.2/26

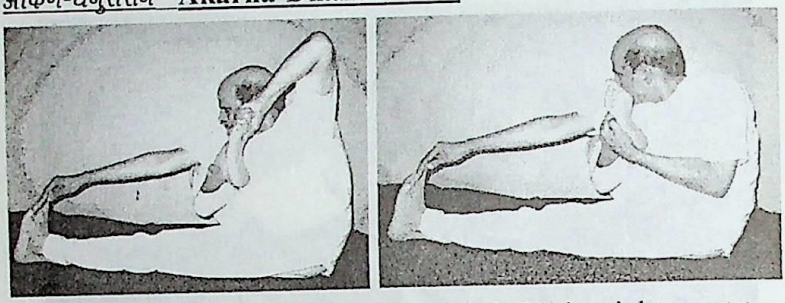
Procedure: Stretching the two legs on the ground like a stick bring the forehead down to touch the knees. Hold the feet or the great toes with both the hands.

Advantages: Pashchimottanasana increases flexibility of the spine by putting stress on the posterior spinal ligaments.

उत्थित पश्चिमोत्तनासन Utthit-paschimottanasana, also known as purna-naukasana adds the balancing skill to the above mentioned advantages.



आकर्ण-धनुरासन Akarna-Dhanurasana



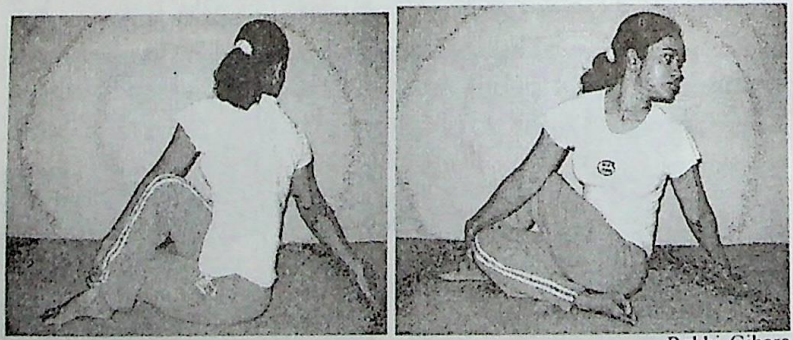
Procedure: Sitting with legs extended, hold the right great toe with the left hand. Now flex the left knee, hold the left foot with the right hand and pull it to touch the right knee.Then repeat it on the other side.

Another version is to hold the left foot from below and flexing the biceps elevate it to the right ear.

Advantages: Improves flexibility of the hip and knee joint.The first version strenghthens the deltoid while the second version strenghthens the biceps muscles.

अर्धमत्स्येन्द्रासन Ardha Matsyendrasana

वामोरुमूलार्पित दक्षपादं जानोर्बहिर्वेष्टित वामपादम् ।
प्रगृह्य तिष्ठेत्परिवर्तिताङ्गः श्रीमत्स्यनाथोदितमासनं स्यात् । हठप्रदीपिका 1/26



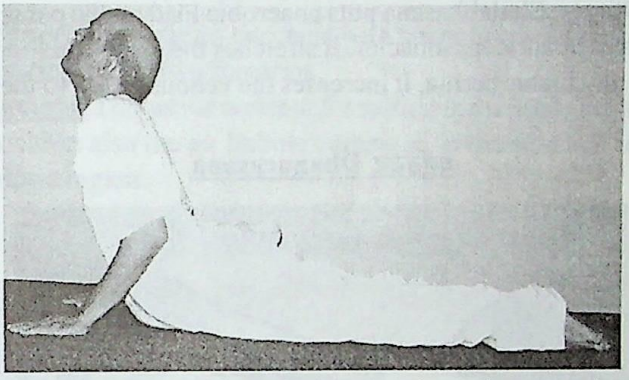
Rakhi Gihara

Procedure: Sit with legs extended, flex the right knee, lift it so as to place the right foot in the neighborhood of the left knee. Flex the left knee and insert the left heel under the right hip. Turn rightwards, push the right knee with the left elbow and hold the right foot. Turn backwards look back.

Advantages: ***Ardha-matsyendrasana*** stretches the spinal ligaments and improves flexibility. It puts anaerobic load on the paraspinal muscles.

भुजंगासन Bhujangasana

अंगुष्ठनाभिपर्यंतम् अधोभूमौ च विन्यसेत् ।
धरां करतलाभ्यां धृत्वोर्ध्वशीर्षः फणीव हि ।। घे.2/42

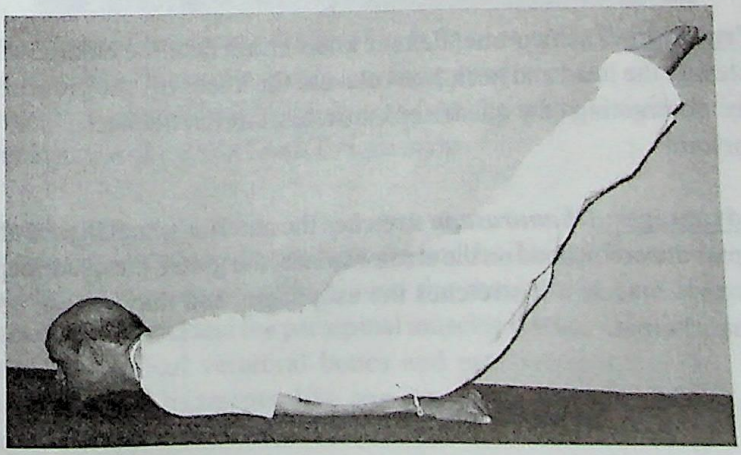


Procedure: Lie prone. Keep the two hands on the ground on both the sides of the shoulders. Now elevate the head, neck and chest in that order, like a serpent. Keep the elbows half flexed. Stay in this position for 90 seconds, then come down.

Advantages: Bhujangasana puts anaerobic load on the erector spinae muscles, the triceps and other extensors of the forearm

शलभासन Shalabhasana

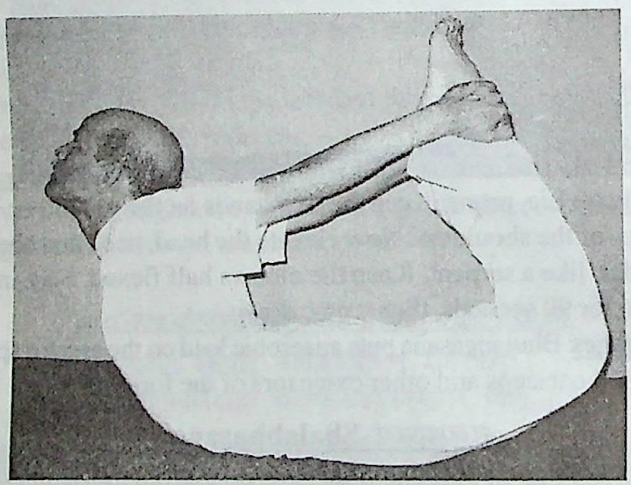
अध्यास्य शेते करयुग्मवक्ष आलम्ब्य भूमिं करयोस्तलाभ्यां ।
पादौ च शून्ये च वितस्ति चोर्ध्वं वदन्ति पीठं शलभं मुनीन्द्राः ।घे.2/39



Procedure: Lie down prone on the ground. Stretch the arms under the belly with closed fists pointing towards the ground. Now elevate the lower part of the body gradually keeping the legs and the thighs fully extended. Keep breathing.Stay in this position for about 30-60 seconds.

Advantages: Shalabhasana puts anaerobic load on the paraspinal, glutei and quadriceps muscles. It stretches the esophagus and may repose any hiatus hernia. It increases the venous return to the heart

धनुरासन Dhanurasana

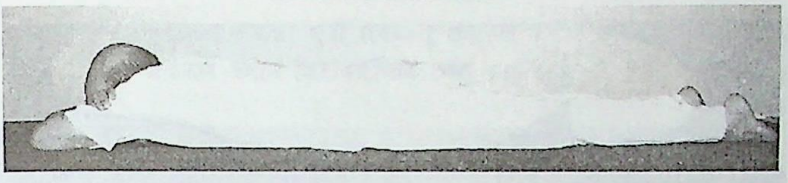


प्रसार्य पादौ भुवि दण्डरूपौ करौ च पृष्ठे धृतपादयुग्मम् ।
कृत्वा धनुर्वत्परिवर्तिताङ्गं निगद्यते वै धनुरासनं तत् ।। घे.2/18

Procedure: Lying prone, flex the knees, hold near the ankles. Elevate the head and neck.Now elevate the knees off the ground. By contracting the quadriceps muscles, stretch the back, look forwards

Advantages: ***Dhanurasana*** stretches the anterior spinal ligaments. It puts anaerobic load on the erector spinae, the glutei, the quadriceps femoris muscles. It stretches the esophagus and may repose any hiatus hernia.

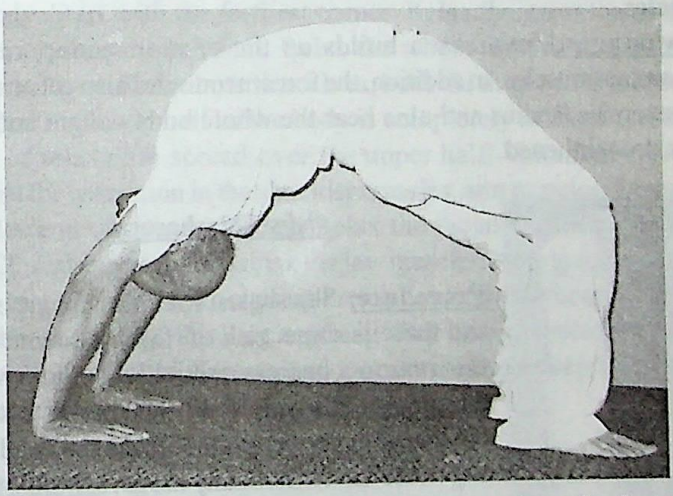
मकरासन Makarasana



Procedure: Lie prone on the chest with upper limbs folded and the head resting on the two forearms.

Advantages: This asana is meant for resting in the prone position.In this position also the air bubble contained in the stomach reaches the pyloric region.

चक्रासन Chakrasana

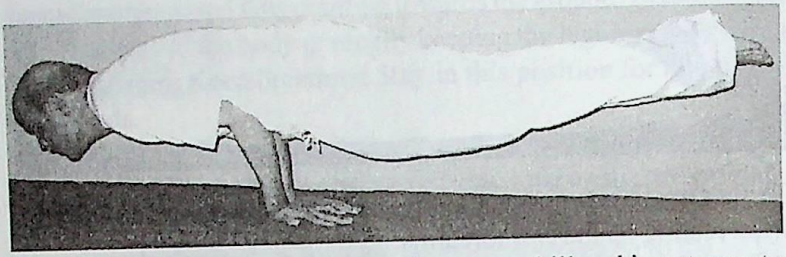


Procedure: Lie supine, flex the knees so as to place the feet near the buttocks. Place the hands on the ground near the shoulders. Now elevate the whole body so as to bear the entire weight on the four limbs making the trunk like an arch.

Advantages:

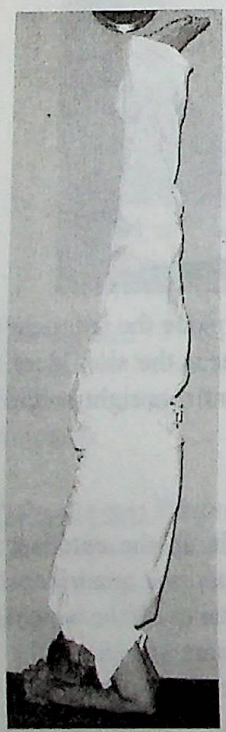
Chakrasana puts anaerobic load on and builds up the extensor muscles of the arm, muscles around the shoulder, the quadriceps femoris, the glutei and the paraspinal muscles.It takes off the weight from the cervical vertebral bones and puts some strech on the cervical spinal ligaments; like one gets in the cervical traction in physiotherapy.

मयूरासन Mayurasana



Procedure: Mayurasana also requires great skill and is not easy to perform for a beginner. It is a balancing act whereby the whole weight of the body is on the two elbows.However, one should practice the bhujangasana and shalabhasana for several days to weeksbefore one will get adequate strength in the erector spinae muscles.

Advantages: Mayurasana builds up the erector spinae, rectus abdominis muscles. In addition, the forearm muscles also get anaerobic exercise.Radius and ulna bear the whole body weight and are thus strenghthened.



शीर्षासन Shirshasana

Procedure: Shirshasana requires some skill and there is some risk of falling down . For this reason a beginner should attempt it with the support of a wall. Fold the elbows to keep the forearms on the ground. Place the head between the hands.Gradually move forwards, then elevate the feet off the ground.Then make the body straight.

Advantages: Shirshasana has same advantages as Sarvangasana. In addition, it puts the whole body weight on the cervical vertebral bodies and then strenghthens them. All the visceral advantages are obtained, for example, the circulatory, respiratory and gastrointestinal system effects are similar to sarvangasana.

शवासन Shavasana

उत्तानं शववत् भूमौ शयनं तु शवासनं ।
शवासनं श्रमहरं चित्तविश्रान्तिकारणम् ।। घे. 2/19

Procedure: Lie supine with hands on either side of the body, legs separated and ankles laterally rotated. Close the eyes. Do not move any part of the body. Imagine and voluntarily relax every part of the body. Start with the farthest corner. Relax the great toe of the right foot, then the left foot. Relax the whole right foot, then the whole left foot. Relax both the calves, both the thighs in this order. Feel that the lower half of the body is completely relaxed. Let the wave of relaxation spread over the upper half. Voluntarily relax and feel the relaxation in the shoulder muscles, arm muscles, forearm muscles and the hand muscles. Relax the facial muscles one-by-one. Close the eyes lightly, relax the jaw muscles. Now give attention to the incoming and the outgoing breath. Listen to the heart sounds. Feel that you are not thinking anything. Stay in this relaxed position for about 20 minutes. Sometimes one may go into a deep sleep, the re is no harm in it.

Advantages: Regular practice of shavasana gradually brings down the sympathetic vasocostrictor tone and brings down the resting blood pressure.

V

The Pranayams

Let us first see what the ancient scriptures have to say about this.

एवं विधि विधानेन प्राणायामं समाचरेत् ।
आरम्भे प्रथमे कुर्यात् क्षीराज्यं नित्यभोजनम् ।
मध्यान्हे चैव सायान्हे भोजनद्वयमाचरेत् ।।घे.स.5/32

'In the way described one should practice regulation of breath. At first one should decide to take meals twice a day.'

कुशासने मृगाजिने व्याघ्राजिने च कम्बले ।
स्थूलासने समासीनः प्राङमुखो वाप्युदङ्मुखः ।
नाडीशुद्धिं समासाद्य प्राणायामं समभ्यसेत् ।।घे.स.5/33

नाडीशुद्धिं कथंकुर्यान्नाडीशुद्धिं तु कीदृशी ।
तत्सर्वं श्रोतुमिच्छामि तद्वदस्व दयानिधे ।।घे.स.5/34

'How are the nostrils cleaned? What is meant by purification of the nasal airways? All that I want to listen, Oh merciful, please tell me all.'

मलाकुलासु नाडीषु मारुतो नैव गच्छति ।
प्राणायामः कथं सिध्येत्तत्त्वज्ञानंकथं भवेत् ।।
तस्मान्नाडीशुद्धिमादौ प्राणायामं ततोऽभ्यसेत् ।।घे.स.5/35

'If the nasal airways are chocked with filth, air can not enter them. Then how can one master regulation of breath and how can one achieve knowledge of the self? For this reason, at first cleaning of nasal passages, then one should practice regulation of breath.'

नाडीशुद्धिर्द्विधा प्रोक्ता समनुर्निर्मनुस्तथा ।
बीजेन समनुं कुर्यान्निर्मनुं धौतिकर्मणा ।।घे.स.5/36

'For cleaning of nasal passages two methods have been described, "samanu" and "nirmanu"; of which by samanu is meant 'along with recitation of a beej mantra' and nirmanu is by the procedure described to wash the nasal passages.'

धौतिकर्म पुरा प्रोक्तं षट्कर्मसाधने यथा।
श्रुणुष्व समनुं चण्ड नाडीशुद्धिर्यथा भवेत्।। घे.सं 5/37

'Of these the procedure to wash the nasal passages has already been described along with "shat-karma". Now O chanda listen to what is called samanu.'

उपविश्यासने योगी पद्मासनं समाचरेत्।
गुर्वादिन्यासनं कुर्याद्यथैव गुरुभाषितम्।
नाडीशुद्धिं प्रकुर्वीत प्राणायामविशुद्धये।।घे.स.5/38

'Sitting comfortably in Padmasana, remembering one's guru and according to the procedure taught by one's guru, one should perform cleaning of nasal passages, then one should practice regulation of breath.'

वायुबीजं ततो ध्यात्वा धूम्रवर्णं सतेजसम्।
चन्द्रेण पूरयेद्वायुं बीजं षोडशकैः सुधीः ।।घे.स.5/39

चतुः षष्ट्या मात्रया च कुम्भकेनैव धारयेत् ।
द्वात्रिंश मात्रया वायुं सूर्यनाड्या च रेचयेत् ।।घे. 5/40

उत्थाप्याग्निं नाभिमूलात् ध्यायेत्तेजोऽवनीयुतम् ।
वह्निबीजषोडशेन सूर्यनाड्या च पूरयेत्।।घे.स.5/41

चतुः षष्ट्या मात्रया च कुम्भकेनैव धारयेत् ।
द्वात्रिंशन्मात्रया वायुं शशिनाड्या च रेचयेत् ।।घे. 5/42

The meaning of all this is: 'Draw in air through theleft nostril counting upto 16, hold the breath inside counting up to 64 and then exhale through the right nostril counting up to 32. Then inhaling through the right nostril repeat the process.'

Physiology of respiration

We shall consider some salient points only.

Control of respiration: In comparison with the other main systems of the body such as the cardiovascular or the renal system the

respiratory system is different in several ways.

Unlike other systems the respiratory system so intensely depends upon the medullary respiratory centre that it can be said that like retina the respiratory system is also an offshoot of the central nervous system. This issue needs to be considered in somewhat greater details.

The respiratory centre is a group of neurons in the medulla oblongata- the lowermost part of the central nervous system. It receives afferent impulses via several cranial nerves-the trigeminals, glossopharyngeals and the vagi- and also proprioceptive impulses from the skeletal structures of the thoracic cage (The ribs and the intercostal muscles), and the diaphragm.The respiratory centre sends efferent connections to the intercostal muscles and the diaphragm.

Normally the rate and depth of respiration is adjusted by the respiratory centre according to the need of the body at that given time; the need to maintain the paO_2 and $paCO_2$ within the normal range. Out of these two parameters, the pCO_2 is the primary drive: we breath as much as is needed to keep the pCO_2 under the upper limit of normal. In simpler words, normally the respiratory centre does not alow the pCO_2 to rise, and when that is done, the paO_2 itelf remains well above the lower normal limit.When someone's respiratory centre does allow the pCO_2 to rise, we call it 'respiratory failure' and then the person breaths as much as is required to keep the pO_2 within normal limits, we say the respiratory centre is working on the anoxic drive.

In the cardiovascular system the heart can function normally even when the nerves going to the heart are cut. Both the sympathetic nerves and the vagus can be cut and the heart still performs its functions normally. Not only that, although the baroceptor-mediated reflexes are important for maintaining the cardiovascular homoeostasis, the heart itself is normally capable of regulating the blood volume by other means as well. Two examples are the atrial natriuretic peptide and the brain natriuretic peptide, both secreted by the heart which help regulating the blood volume.

The kidneys also can function normally in absence of an intact nerve supply. Although normally the β–receptors mediate the secretion of renin, the secretion can go on without sympathetic innervation as well.

In contrast , if the nerves to the intercoastal muscles and the diaphragm are cut the respiration stops and the individual dies. For this reason, when it is decidedly true that the medullary respiratory centre has to regulate the respiration not only from minute-to-minute but from second-to-second; it is easy to understand that the respiratory centre would need all pertinent information in real time. Indeed it is now well known that a wide range of information reaches the respiratory centre which includes the degree of stretch on the lung alveoli, the degree of contraction of the intercoastal muscles and the diaphragm, the air content of the thorax,and most likely the volume of air flown in one or the other nostrils. Whether the nasal mucosa can perceive the direction of air flow through perception of the direction of stretch over its cilia is definitely a subject to be studied.Such a study may be indeed, very difficult to perform because the information may not be reching the conscious level. If we try, we can perceive the direction of flow in the nose, throat and the trachea and there is all reason to believe that the medullary respiratory centre gets the information regarding the air flow with each inspiration and expiration.

In addition, the information regarding the blood gas content-like the paO_2 and the $paCO_2$ which is being constantly watched by the chemoreceptors also continuously reaches the respiratory centre.Using all this information the respiratory centre regulates the minute volume-i.e. the volume inhaled and exhaled per minute. Normally all the data from the various sources is added up to synthesise all the useful information.

Also, normally all the data are congruent. For example, when we inhale a certain amount of air, the information about the volume of air flow through the nostrils matches the degree of stretch of the lung alveoli, the degree of contraction of the intercoastal muscles and the diaphragm.

We will see what happens when the data becomes incongruent-i.e. some data does not match the information from the other sources. (See box)

So the respiratory system more closely depends upon the medullary regulatory centre. That is the reason why we call the

failure of this centre to respond to increases in pCO_2 as 'respiratory failure' while the terms 'cardiac failure' and 'renal failure' are applied to failures of the heart and the kidney organs respectively.

It appears that the full information regarding the air content of the thorax reaches the CNS through different afferent impulses, the degree of stretch of the lung alveoli, of the thoracic cage and the inspiratory muscles etc. If one inhales pure **nitrous oxide**, the information that a certain volume has been inhaled reaches up the CNS. However, since the gas is highly lipid soluble and completely diffuses into the blood stream; hardly anything is left in the lung alveoli to be exhaled out. This experience is very unique and very different from the life-time experience that we have been exhaling whatever amount we inhaled, it is so amusing and amasing that it produces instant **laughter**.

Now let us consider why a distressful sensation results from breathholding. The sensation resulting from prolonged breathholding is variously described as tightness in the chest, suffocation and ghabarahat. This has been supposed to be resulting from hypercapnea -a little bit erroneously. We can ward off that sensation by performing false inspiratory-expiratory movements. We can tolerate much higher degree of hypoxia or even hypercapnia than is produced by breathholding beyond 60 seconds; because in individuals after breathholding to maximum, if a gas mixture is given containing low O_2 and high CO_2 they can tolerate this for another 20 seconds or so.

Hence the most likely reason for the tightness sensation and sensation of suffocation -ghabarahat- appears to be the lack of cyclic afferent information reaching the medullary respiratory centre. When the centre perceives the absence of of respiratory air flow it relays the information to the higher centres; like alarm.

The nasal mucosa as well as the skin of the philtrum is thermo-sensitive: Although hot and cold sensation is present all over the body surface, the skin over the philtrum appears specially sensitive to temperature and it has been given the task of sensing the temperature of the inhaled and the exhaled air.

Also it seems that (In right handed persons) the left nostril is sensitive to cold air. It will get congested on exposure to cold and

may start running. There are conditions recognized in the medical science as vasomotor rhinitis, which we have discussed earlier.

The eight different types of pranayamas

सहितः सूर्यभेदश्च उज्जायी शीतली तथा ।
भस्त्रिका भ्रामरी मूर्च्छा केवली चाष्ट कुंभकाः ।।घे.स.5/46

'There are eight **"*kumbhakas*"** namely ***sahita*, *suryabheda*, *ujjayi*, *sheetali*, *bhastrika*, *bhramari moorchha* and *kevali*'.**

The meaning of purka is filling in air, of kumbhaka isretaining the breath inside, rechaka is exhaling.

सहित प्राणायाम Sahita Pranayam

Procedure: Draw in air though the left nostril, counting up to 16, then holding the breath by closing both the nostrils, make the sucking-in effort (Uddiyan Bandh) while counting up to 64, then release the breath through the right nostril counting up to 32. Repeat the process to complete the cycle.

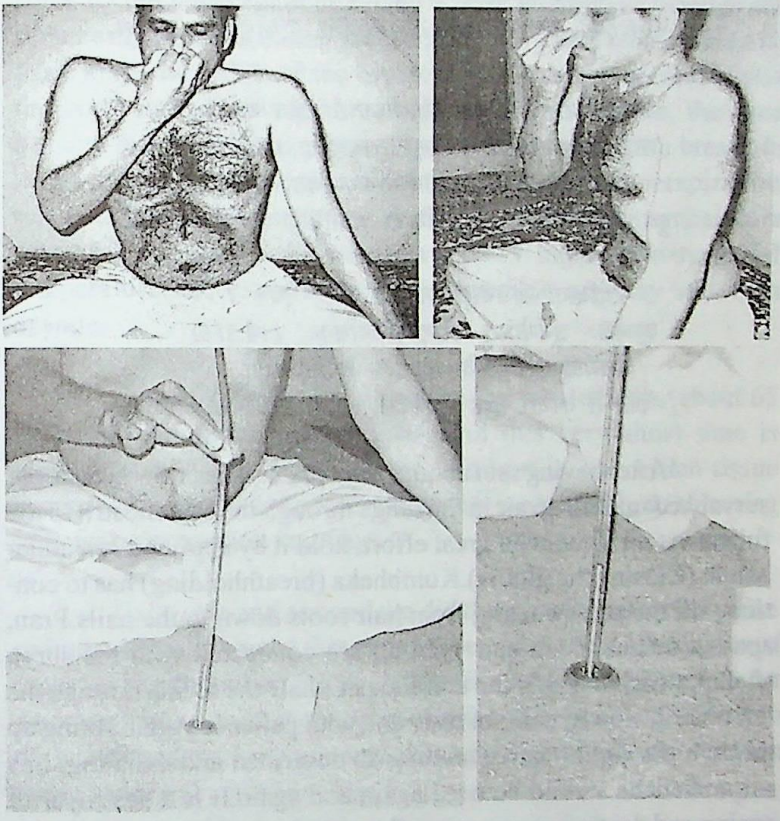
सहितो द्विविधः प्रोक्तः सगर्भश्च निगर्भकः ।
सगर्भो बीजमुच्चार्य निगर्भो बीजवर्जितः ।।घे.5/47
प्राणायामं सगर्भं च प्रथमं कथयामि ते ।
सुखासने चोपविश्य प्राङ्मुखो वाऽप्युदङ्मुखः ।
रजोगुणं विधिं ध्यायेद्रक्तवर्णमवर्णकम् ।।घे.5/48
इडया पूरयेद्वायुं मात्रया षोडशैः सुधीः।
पूरकान्ते कुम्भकाद्ये कर्तव्यस्तूड्डियानकः ।।घे.5/49

The pranayama described as sahita must have great physiological effects. Nowhere in the modern physiology have we studied the effects of negative pressure inside the alveoli. Sahita pranayama creates a situation just reverse of what the modern physiologist knows as Valsalva's maneuver.

For this reason it can be named as Avlaslav maneuver! (Avlaslav is Valsalva read backwards).

Here one has to fill in a normal breath, and then, closing the nostrils, perform a sucking-in effort so as to create maximum negative pressure inside the thorax. In an experiment showing the pressure so created, one can show it to be 70-110 mm of Hg below atmospheric pressure according to one's physical capacity.

In effect, the pressure of the alveolar air is reduced to about 650-700 mm Hg which is equivalent to climbing up an altitude of 900-1100 meters above where you are.



Secretion of erythropoietin is known to be facilitated by the alkalosis that develops at high altitudes. Whether performing sahita pranayama for a few minutes everyday is good enough to stimulate production of erythropoietin remains to be seen, nevertheless, a few minutes may be better than none at all.

सूर्यभेदन प्राणायाम Suryabhedana Pranayama

Yogis around us are rarely seen to demonstrate *Suryabhedana.* So I had to take clues from the scripture and proceed on my own. It was a thing that required courage; holding your breath till there is profuse sweating! However, with persistent effort it is demonstrable that when the breath is held for long enough cycle after cycle, profuse perspiration results.

कथितं सहितं कुम्भं सूर्यभेदनकं श्रुणु ।
पूरयेत्सूर्यनाड्या च यथाशक्ति वहिर्मरुत् ।।घे.5/58
धारयेद्वहुयत्नेन कुम्भकेन जलन्धरैः ।
यावत्स्वेदं नखकेशाभ्यां तावत्कुर्वन्तु कुम्भकम् ।।घे.5/59

प्राणोऽपानः समानश्चोदानव्यानौ तथैव च ।
सर्वे ते सूर्यसंभिन्ना नाभिमूलात्समुद्धरेत् ।।घे.5/60
इडया रेचयेत्पश्चाद्धैर्येणाखण्डवेगतः ।
पुनः सूर्येण चाकृष्य कुम्भयित्वा यथाविधि ।।घे.5/61

रेचयित्वा साधयेत्तु कमेण च पुनः पुनः ।
कुम्भकः सूर्यभेदस्तु जरामृत्युविनाशकः ।।घे.5/62
वोधयेत्कुण्डली शक्तिं देहाग्निं च विवर्धयेत् ।
इति ते कथितं चण्ड सूर्यभेदनमुत्तमम् ।।घे.5/63

'After having said about sahita pranayama, now hear about suryabhedana.Fill up air in the lungs through the right nostril to the fullest extent.Then with great effort, hold it by applying Jalandhar bandh (Closing the glottis).Kumbhaka (breathholding) has to continue till there is sweating from hair roots down to the nails.Pran, apana, samana, udan and vyan all are connected with the surya chakra, which lies near the umbilicus.Exhale the breath through the left nostril, slowly, continuously and with patience.Again filling up through the right nostril, holding as described and exhaling, this suryabhedana should be tried again and again.It is a destroyer of ageing and death, increases agni (heat) in the body and awakens the kundali shakti.This way O Chanda! I have described to you the best Suryabhedana' Gheranda Sanhita 5/58-63.

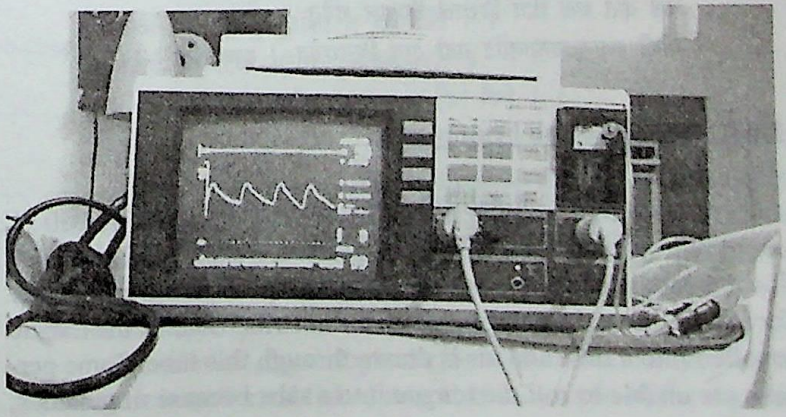
Our experiment shows

Suryabhedana is thermogenic in the short run To study the effects of Suryabhedana we conducted a short experiment. Two candidates participated in the experiment. The body temperature was measured initially. One had a temperature of 97° F while the other had a temperature of 96.8° F. (In cold climate the body temperature often dips much below the arrow mark in the clinical thermometer). Suryabhedana pranayama was done as under: We drew in air through the right nostril. Then we closed both the nostrils and held the breath for as long as possible. When some sensation of suffocation started,

we still held the breath for another 5-6 seconds and when ultimately it became irresistible to hold it further,we released the breath through the left nostril.Immediately, without allowing any time to lapse; we filled up the lungs again by taking a deep inspiration through the right nostri, again repeating the process. Every time when it became irresistible, we still held the breath for another 5-6 seconds.Soon the body started getting heated up. Cycle-after-cycle, the time became lesser and lesser up to which we could hold the breath.In just 4 cycles-which required about 4.30 minutes; perspiration resulted.(See the cover photo). At this stage the body temperature was measured again and it was seen to be 2°F higher than the initial temperature.The experiment is reproducible any day and with anyone.

Considering the large mass of the whole body, (about 65 kg,) the amount of heat generated in this very short time is considerable! What the source of this heat is -i.e; which tissue produces it- remains to be studied, as there is apparently no shivering or muscle contraction involved..

To be safe and assured we did the experiment with a pulse oximeter which showed that even at the end of the 4.30 minutes of repeated breathholding the SpO_2 remains 99%- nothing to fear for a person having normal coronary arteries. For everyone willing to try suryabhedana I recommend that initial effort should be done with a pulse oximeter connected.



Pulse-oximeter

At first it occurred to us that sympathetic nervous system stimulation must be the cause for the sweating, however, other features like tachycardia and hypertension are absent. The sweating occurs even at pleasant room temperature.

In the long run, effect of persistent practice of suryabhedana is that after a few days the palms become redder than earlier. This is probably related to the inhibition of sympathetic vasoconstrictor tone with resulting vasodilatation. The palms also become dry with inhibition of sweating, this way it may find therapeutic application in cases of abnormal, troublesome palmer sweating.

The breath-holding can be prolonged by performing false inspiratory-expiratory movements.

These, probably by sending information to the apneustic centre in the medulla oblongata reduce the urgency to resume breathing and allow more carbon-dioxide to accumulate.

In our small experiments, at the climax of breathholding we have noticed that there is some curious sensation in the genitals, which is similar to emission, (i.e. the movement of semen into the urethra,which normally occurs before ejaculation during sexual intercourse). After a few days regular practice of *suryabhedana* one may notice that there is a delay in penile retraction (recoil) after sexual intercourse which again is due to reduced sympathetic system activity to the penis. What is the relation between this sensation and the phenomenon described as *kundalini jagran* is not known to me.

चले वाते चले चित्तं निश्चले निश्चलं भवेत् ।
योगी स्थाणुतवमाप्नोति ततो वायुं निराधयेत् । हठप्रदीपिका 2/2

शीतली प्राणायाम Sheetali Pranayama

जिह्वया वायुमाकृष्य चोदरे पूरयेच्छनै : ।
क्षणं च कुम्भकं कृत्वा नासाभ्यां रेचयेत्पुनः । घे. सं. 5/68

'Draw in air through the nose, and performing kumbhaka for a short time exhale through both the nostrils.'Usually the tongue is rolled into a tube and air is drawn through this tube. Some persons are unable to roll the tongue into a tube because of genetics, they should draw in air through the tongue folded backwards.'

By its physiological effects, sheetali rnayama can be used in two ways. On the one hand one can use it to open a congested nose. The principle is as follows: While performing sheetali pranayama we are actually taking in the cold air through the *mouth* so as to byepass the nose which has reacted to cold. Then, after allowing the air to get heated inside the thorax we are exhaling it through the nose. Flow of warm air through the nasal passages opens them.

Second use of sheetali pranayama is for constricted bronchial airways. Here, because of the narrow aperture of the rolled up tongue we can draw air producing greater subatmospheric pressure inside the thorax.This subatmospheric pressure applied from outside the collapsible airways puls their walls apart and in effect causes bronchodilatation. In bronchial asthma the narrowed airways suffer from frictional injury due to the flowing air and thus get further inflamed.Here, slight dilatation of the brinchi can break the vicious cycle of injury→ inflammation→ narrowing→ frictional injury→inflammation and regular practice of sheetali pranayama can restore normal bronchial diameter if permanent changes have not occured.

भस्त्रिका प्राणायाम **Bhastrika Pranayama**

भस्त्रिका लोहकाराणां यथाकमेण संभ्रमेत् ।
तथा वायुं च नासाभ्यामुभाभ्या चालयेच्छनै : ।।
एवं विंशतिवारं च कृत्वा कुर्याच्च कुम्भकम् ।
तदन्ते चालयेद्वायुं पूर्वोक्तं च यथाविधि । ।
त्रिवारं साधयेदेनं भस्त्रिकाकुम्भकं सुधीः ।
न च रोगो न च क्लेश आरोग्यं च दिने दिने । ।

घे. सं. 5/70-72

'Move air in and out like the bellows of a blacksmith, using both the nostrils.Doing so twenty times,perform kumbhaka and then exhale as described.The wise men perform this Bhastrika three times in one sitting. there will be no disease or suffering; and health will improve day-by-day.'

The clinico-physiological effects of Bhastrika can be miraculous. It is well established now that ischaemia of the myocardium is a stimulus for the developement of coronary collaterals.

Our study shows Bhastrika can produce hypoxia.

It is well known that hyperventilation washes off carbon-dioxide and thus eliminates the main stimulus for respiration. For this reason, while performing bhastrika; after twenty breaths when one stops breathing, the breathholding can be prolonged. We have conducted a short study using the pulse oximeter. We have demonstrated that an SpO_2 of 79% is achieved in the first attempt. With repeated efforts and encouragement one can be able to hold the breath for longer, thus producing more hypoxia. It may result in a transient ischaemia of those regions of the myocardium where the coronary artery is narrowed due to atherosclerosis. This ischaemia then stimulates formation of several growth factors leading to angiogenesis. We have discussed it further elsewhere in this book.

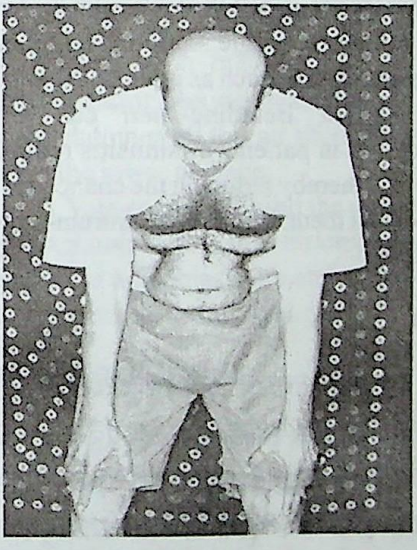
Thus, Bhastrika can benefit the practitioner by producing hypoxia. In the long run one is endowed with a coronary tree which has rich collaterals!

VI
Internal Cleansing processes

1.Nauli Kriya :

Procedure:

One has to stand slightly bent forward with the palms resting on the knees. Then after exhaling and closing the glottis the thorax is expanded in maximal inspiratory position and the rectus abdominis muscles are contracted. Thus they become prominent and the lateral portions of the abdomen are sucked in. Then by alternately contracting the right rectus while relaxing the left, rotary movement is performed.



Advantages:

1. It gives exercise to the abdominal muscles especially the rectus abdominis muscle.

2. It creates a sub-atmospheric pressure in the abdominal cavity and this way facilitates blood flow in the large veins from the lower half of the body.

3. Air may be sucked into the rectum inhibiting anaerobic organisms.

4. In women it can help repose the uterus which has a tendency to move down (prolapse).

5.Due to breathholding for that much time all benefits of Bhastrika are also obtained with Nauli.

2.Neti :

Jal-neti is the easier to perform. There is one special utensil (Lota) which has a nozzle -tubular outlet- the tip of which is made conical specially designed to fit in the nostril. With the head tilted slightly in one direction and using clean, warm saline water one has to apply it to one of the nostrils. On tilting the utensil the saline water enters into it, flows back to the nasopharynx and comes out of the other nostril.

It mechanically washes away any dust particles and disease-producing microorganisms which may be settling in the nasal cavity or the para nasal sinuses.

Scientific modifications:

Traditionally for *neti*, lukewarm salt-water is employed, but modern day antiseptic gargle solutions which are harmless to the nasal mucous membrane -such as povidone-iodine- can be added to the solution: So that "Betadine- *neti*" can be said to be my invention. Use of neti in patients of sinusitis reduces the need for systemic antibiotics, thereby reducing the chances of all the adverse effects associated with them. With this an antrum-puncture operation may not be needed.

3.Kunjal Kriya

कफं पित्तं तथा क्लेदं रेचयेदूर्ध्ववर्त्मना ।
दण्डधौतिविधानेन हृद्रोगं नाशयेद् ध्रुवम् ।। घे. 1/37
भोजनान्ते पिबेद्वारि चाकण्ठं पूरितं सुधीः ।
ऊर्ध्वा दृष्टि क्षणं कृत्वा तज्जलं वमयेत्पुनः ।
नित्यमभ्यासयोगेन कफपित्तं निवारयेत् ।।घे. 1/38

'One should throw out by the upper passage phlegm, bile and mucus. By practicing *Danda dhauti* one can get rid of the diseases of the gullet. After meals one should drink water till it comes up to the throat, lok upeards for a while and then throw out the water. By constant practice of this, one can ward off diseases due to phlegm and bile'.

Procedure: One should drink water up to the throat .then one can induce vomiting by introducing two or three fingers in the throat.

Advantages: The advantages may reach beyond the gastrointestinal tract. Inducing vomiting activates the vomiting centre and the vagus nerve; and in one way may contribute to strengthening the parasympathetic system. During vomiting both the sympathetic and the parasympathetic activities are seen to emerge.

4.Vata-sara:

वातसारं परं गोप्यंदेहनिर्मलकारकम् ।
सर्वरोगक्षयकरं देहानलविवर्धकम् ।। घे. सं. 1/16

Vata-sara is a to be kept secret. It is a great purifier, destroyer of all diseases and increases the body heat.

Procedure:

काकचञ्चूवदास्येन पिबेद्वायुं शनैः शनै : ।
चालयेदुदरं पश्चाद्वर्त्मना रेचयेच्छनै : ।।घे. 1/15

One should drink air making the mouth like a crow's beak. Then by moving the abdomen all this air should be moved down to be expelled through the lower passage.

Advantages: Vata-sara can inhibit the anaerobic organisms residing in the gut. It is noteworthy that *Entamoeba histolytica*, the causative organisms for amoebiasis are strict anaerobes and they are inhibited when air moves through the gut.

5.Vari-sara (Shankha-prakshalana)

आकण्ठं पूरयेद्वारि वक्त्रेण च पिबेच्छनैः।
चालयेदुदरेणैव चोदराद्रेचयेदधः ।।
वारिसारंपरं गोप्यंदेहनिर्मलकारकम् ।
साधयेत्तत्प्रयत्नेनदेवदेहं प्रपद्यते ।। घे. सं. 1/17-18

'Drink water up to the throat, then move the abdomen so that to pass the water through the lower passage. This Varisara purifies the body and should be kept secret and mastered with great effort.'

Shankh prakshalana is literally, washing of a conch shell. Just as a conch shell requires to be rotated in order to be washed thoroughly, the intestines also can be washed only if they are thoroughly rotated. In yogic practices this is achieved by performing particular exercises which increase intestinal motility temporarily,

thus causing the large volume of water gulped to move down the intestines and resulting into watery loose motions.

Procedure: Preparation is done the previous night by taking light diet without *ghee*. In the morning the procedure is started. 4 glassfuls of salted warm water are gulped down rapidly, followed by five different types of exercises. (See fig.) Soon bowel evacuation occurs, at first of solid motion but soon semisolid and liquid stool starts coming out. After 3-4 evacuations, clear, colorless water starts coming out. After this has happened 3-4 times, exercise is stopped and rest taken in *shavasana*. After this a lot of *Khichri* with about 100 gms of *ghee* is fed which stops the loose motions (Fat delays gastric emptying and slows peristalsis). Next day when the stool is passed one can feel the *ghee* coming out unabsorbed.(Since the bile acid pool has all been washed away so no fat absorption can take place for several days to come)

Advantages:

Shankh-prakshalana can wash away any noxious bacteria which may have colonized the gut. We have seen in the yoga camps that sometimes even the intestinal worms are passed out. Once the undesired flora are washed out, one can attempt to regenerate good type of bacteria in the gut by taking any standard probiotics which are available in a chemist shop. (Vizylac™, Vizyl™, Bifilac™)

Shankh-prakshalana can reduce the bile acid pool, resulting in reduced fat (Both triglyceride and cholesterol) absorption for the next several days and thus can help reduce obesity. The body will soon regenerate the bile acid pool and this will utilize some cholesterol. Thus, temporarily the blood cholesterol level may be brought down.

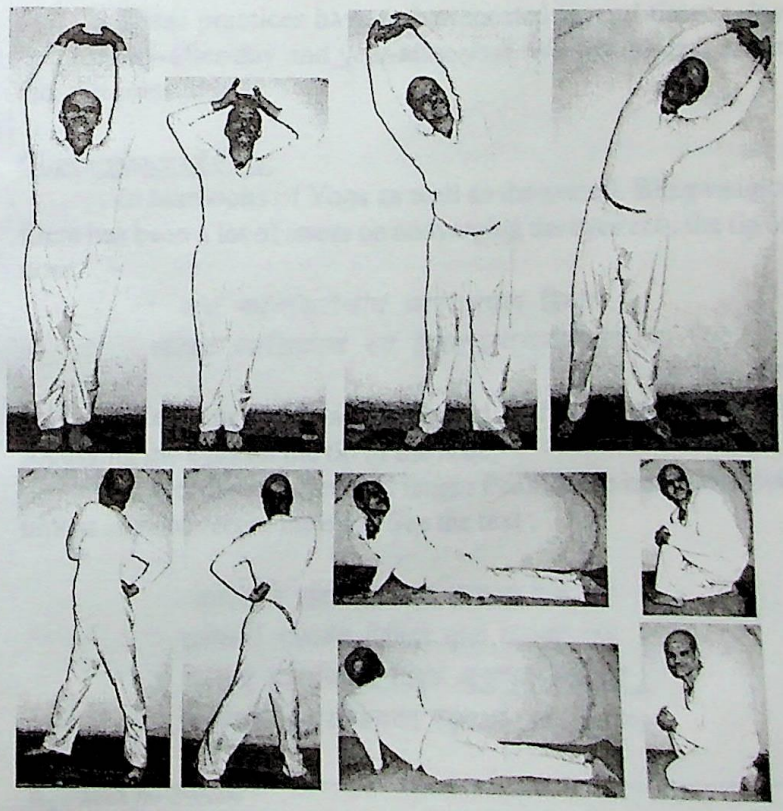
Any sludge present in the gall bladder is also washed out and thus formation of gallstones is postponed.

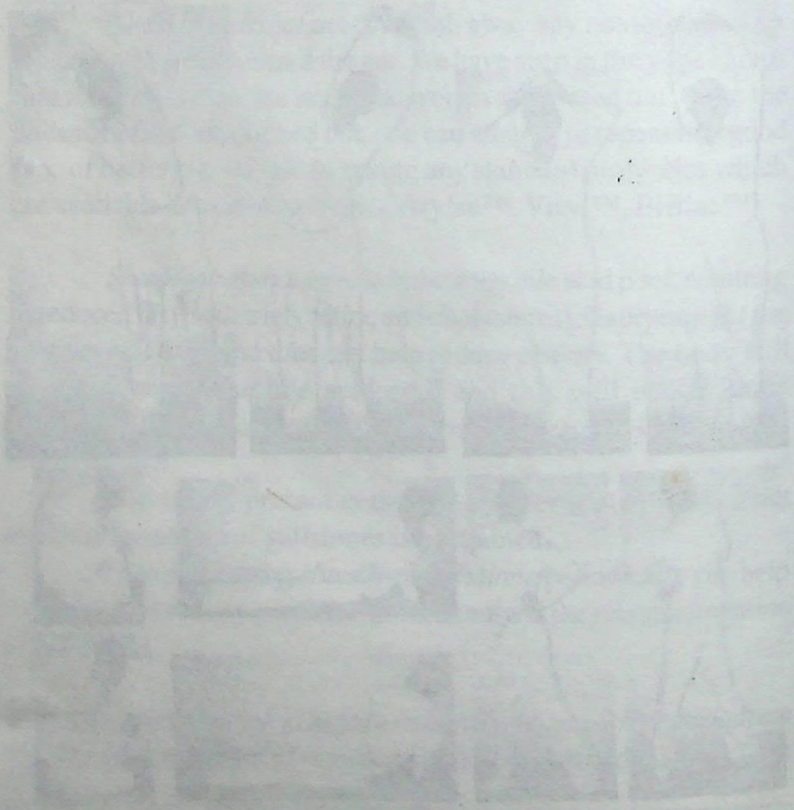
Thus performing *shankh-prakshalana* periodically can help ward off several diseases. Once-in six months is the recommendation of the seers.

Scientific modifications: Before undertaking *shankh prakshalana* it may be wise to take a mega.dose of Vitamin A and vitamin D so

that these are stored in the liver. Otherwise they are not going to be absorbed for the next several days

Shankh prakshalana is not a natural process. And neither is *kunjal kriya*: One is not supposed to induce vomiting or loose motions in nature. But once again; *hatha yoga* is not living according to nature. It is befooling the nature, just as an IUCD is.





VII

Creating parasympathetic dominance

The modern day cardiologist will prefer a parasympathetically dominated person. His temperament remains cool even in face of provoking situations.Such a person has a slow heart rate which does not show great variations, a normal blood pressure without surges,and a normal fibrinogen level.

In Yoga there are several practices that lead to parasympathetic dominance e.g.

1. Convergence of eyes.
2. Reflex provocation of secretion of tears.
3. Inducing vomiting by gagging.
4. Tonic and repeated contraction and relaxation of the anal sphincter. In human the sympathetic supply to the anal sphincter is excitatory and the parasympathetic is inhibitory.

These practices have to be repeated several times a day and for day-after-day and year-after-year. We will discuss about these in some detail.

Convergence of eyes.

In textbooks of Yoga as well as the sacred Bhagwadgita there has been a lot of stress on converging the eyes onto the tip of nose.

समं कायशिरोग्रीवं धारयन्नचलं स्थिरः ।
संप्रेक्ष्य नासिकाग्रं स्वं दिशश्चानवलोकयन् ।
भगवद्गीता 6.13

'Keeping the head, neck and body straight and still, focussing the eyes on the tip of the nose,

In fact the so commonly taught *Padmasana* is not complete unless one converges the eyes. See the text :

वामोरूपरि दक्षिणं हि चरणं संस्थाप्य वामं तथा ।
दक्षोरूपरि पश्चिमेन विधिना धृत्वा कराभ्यां दृढम् ।।
अंगुष्ठौ हृदये निधाय चिबुकं **नासाग्रमवलोकयेत्** ।
एतद्व्याधि विकारनाशनकरं पद्मासनं प्रोच्यते ।।घे.2/8

'Placing the right foot on the left thigh and likewise the left on the right thigh; crossing the hands behind the back to hold the two big toes; placing the chin on the chest, one should turn the gaze to the tip of the nose. This is called *Padmasana* which is capable of destroying all disease.'

.....and *siddhasana*....

योनिस्थानकमङ्घ्रिमूलघटितं संपीड्य गुल्फेतरं
मेढ्रोपर्यथ संनिधाय चिबुकं कृत्वा हृदिस्थापितम् ।
स्थाणुः संयमितेन्द्रियोऽचलदृशा **पश्यन्भ्रुवोरन्तरं।**
ह्येतन्मोक्षकवाटभेदनकरं सिद्धासनं प्रोच्यते ।। घे. 2/7

'Pressing the perineal region with one heel placed against it, resting the other ankle above the penis, placing the chin on the chest remaining motionless with senses under control, and gaze directed towards the middle of the eyebrows.'

.....and *Bhadrasana*.....

गुल्फौ च वृषणस्याधो व्युत्क्रमेण समाहितः ।
पादांगुष्ठौ कराभ्यां च धृत्वा वै पृष्ठदेशतः ।।
जालन्धरं समासाद्य **नासाग्रमवलोकयेत्** ।
भद्रासनं भवेदेतत्सर्वव्याधिविनाशकम् ।। घे.2/10

'Carefully placing the ankles in the reverse manner under the scrotum; crossing the hands behind the back holding the big toes and adopting the jalandhara bandha,one should gaze at the tip of the nose. This is *Bhadrasana* which destroys all diseases.'

.....and *Simhasana*....

गुल्फौ च वृषणस्याधो व्युत्क्रमेणोर्ध्वतां गतौ ।
चितियुग्मं भूमिसंस्थं करौ च जानुनोपरि ।।
व्यात्तवक्त्रोजलन्ध्रेण **नासाग्रमवलोकयेत्** ।
*सिंहासनं भवेदेतत्सर्वव्याधि विनाशकम् ।।*घे.2/15

'One should place the two ankles kept upwards crosswise under the scrotum, front part of the head of the tibia on the ground, hands on the knees, open the mouth, adopt jalandhara bandha,and fix the gaze on the tip of the nose. This is *Simhasana* the destroyer of all disease'.

.....and *Matsyendrasana*...

मुक्तपद्मासनं कृत्वा उत्तानशयनं चरेत् ।
कूर्पराभ्यां शिरो वेष्ट्यं रोगघ्नं मात्स्यमासनम् ।
उदरं पश्चिमाभासं कृत्वा तिष्ठत्ययत्नतः ।
नमितं वामपादं हि दक्ष जानूपरि न्यसेत् ।।
तत्र याम्यं कूर्परं च वक्त्रं याम्यकरेऽपि च ।
भ्रुवोर्मध्ये गतादृष्टिः पीठं मात्स्येन्द्रमुच्यते ।।

घे.2/23

'Assuming the *muktapadmasana* (i.e. without the crossing of the hands) lie supine, surrounding the head by the two elbows. This is Matsyasana. Withdrawing the abdomen at ease towards the back; then bending the left leg and placing the foot at the right knee, place on this knee the right elbow also. Then placing the chin on the right arm fix the gaze between the two eyebrows. This is called *Matsyendrasana'*.

.....and Shambhavi mudra..

नेत्रान्तरं समालोक्य चात्मारामं निरीक्षयेत् ।
सा भवेच्छांभवी मुद्रा सर्वतन्त्रेषु गोपिता ।।

घे. 3/53

'Gazing between the two eyes look inwards to see the witness soul. This is the *shambhavi mudra* which is the most secret of all tantras.'

'Fixing the gaze between the eyebrows inside meditate on the atman. This is the *shambhavi mudra* which is zealously guarded by the all the tantras.'

Given the fact that earlier the yogic sages have been made fun of and labelled as 'nose-tip-gazers'; it is not surprising that our present-day yoga teachers; if at all, do not insist on convergence of the eyes- although it is so well mentioned in the texts and scriptures. **It is distressing that in this way we, the human race may lose this valuable technique.**

त्राटक

निमेषोन्मेषकं त्यक्त्वा सूक्ष्मलक्ष्यं निरीक्षयेत् ।
पतन्ति यावदश्रूणि त्राटकं प्रोच्यते बुधैः ।।

घे0 1.52

Trataka is another procedure that can increase parasympathetic dominance. A lighted candle is placed before the eyes at about a distance of 30 Cms. Sitting comfortably in the lotus posture, the eyes are kept wide open, focusing the gaze on the flame of the candle. Effort is made to resist reflex blinking of the eyelids. After some time the cornea gets irritated and reflexly profuse lachrimation occurs.

<u>वमन</u>

भोजनान्ते पिवेद्वारि चाकण्ठं पूरितं सुधीः ।
ऊर्ध्वां दृष्टि क्षणं कृत्वा तज्जलं वमयेत्पुनः ।।
नित्यमभ्यासयोगेन कफपित्तं निवारयेत् ।घे. 1/38

'After a meal one should drink water to fill up to the throat. Then all that water should be vomited out'.

Gagging stimulates the pharynx and impulses ascend up the glossopharyngeal nerve and activate the vomiting centre situated in the medulla oblongata in the floor of the fourth ventricle. From there impulses flow down the vagus to execute the act of vomiting. In this way a stimulation of the vagus nerve is obtained.

Ashwini Mudra and Mool Bandha

तावदाकुञ्चयेद्गुह्यमश्विनीमुद्रया शनैः ।
यावद्गच्छेत्सुषुम्णायां हठाद्वायुं प्रकाशयेत् ।। घे. 3/46

'By ashwini mudra one should slowly contract the anus till the vayu is forced into the sushumna and gives an experience.'

Ashwini mudra is repeated constriction and relaxation of the anal sphincter while mool-bandha is tonic constriction of the anal sphincter. Both these practices are said to awaken the "*kundalini shakti*", however, the nature of *kundalini shakti* and what achievements occur after its awakening is not clear at present. But it is understandable that repeated practice of this can potentiate the parasympathetic nervous system.

VIII

Application of yoga in disease states

Although yoga has been more of a protective science, it has gained more popularity because it can cure certain diseases. However, it must be understood that in order to get full bebefits, one must set aside at least half to one hour of the daily schedule for the practice of yoga.

1.Obesity:

Obesity is spreading like an epidemic. Not only the developed countries but also the developing countries are all facing this problem alike. Why there is this sudden increase in the incidence of obesity? There are several theories to explain this. However, given the facts that obesity leads to several complications it must be considered the condition to be treated with utmost priority.

While there are several facets to the problem of obesity, it is clear that obesity is associated with shortening of life span and complications which make life difficult for the individual.

Classification:

1. Simple obesity: (95%): Cases in which there is no genetic or hormonal abnormality.

2. As a part of a wider disorder: (5%): Includes-

(a) Genetic Syndromes there are some well recognized syndromes which are known by the names of their inventors, such as the 'Prader Willi Syndrome', the 'Laurence-Moon-Biedl syndrome' etc. Now-a-days great efforts are being done by researchers to precisely identify and locate the defective gene; much success has already been achieved.

(b)Endocrine disorders : Hypothyroidism, Cushing's disease

(c) Hypothalamic lesions: Damage to a certain part of the brain called the hypothalamus-which regulates appetite and feeding behavior and body weight-is rarely ever a cause of obesity.It is also of interest that obesity is largely restricted to humans and animals which are domesticated or in a zoo.

Simple Obesity

Suggested Mechanisms:

Twin studies have been done to find out importance of genetic and environmental influences.

Experimental studies: Obese mice have ob/ob genes. In humans ob genes are found on chromosome no.7. The ob gene is expressed only in the fatty tissue whether white or brown. The product of the ob gene is a 16 kda protein (Hormone) called the leptin. Injection of leptin produces satiety. It is known that the leptin production is proportionate to the amount of adipose tissue. In obese individuals the leptin levels in blood plasma are high. Despite this their appetite continues-obesity can thus be viewed as a case of leptin resistance.

Regulation of body weight:

Certain areas of the brain-called the hypothalamic ventromedial, dorsomedial, paraventricular and arcuate nuclei-are shown to have leptin receptors. The gastro-intestinal tract, after food intake, secretes several chemicals such as cholecystokinin (CCK), bombesin, glucagon-like-peptide, enterostatin and somatostatin. Hypothalamus is also acted upon by several other chemicals such as adrenaline, dopamine, 5-HT, and some cellular messengers called cytokines and named such as Interleukin-1 (IL-1) & tumour necrosis factor (TNF) etc. Other signal like orexin and ghrelin also influence the feeding/satiety centre.

An important chemical acting upon the hypothalamus is a product of the adipose tissue called leptin. Injected leptin produces satiety. Leptin is found in higher concentrations in the obese persons.Therefore obesity can be viewed as a case of leptin resistance.

A force-feeding usually leads to production of more body heat (thermogenesis) mediated by a modified thyroid hormone-the *reverse T3*, but a prolonged increased intake of food-which provides a small surplus of calories- in the long run leads to significant weight gain. Once gained the weight becomes hard to lose, as homoeostatic mechanisms will try to maintain it at the new level.

Determinants of body weight: The body weight is a result of interplay between two opposing factors- the food intake and the energy expenditure, which themselves depend upon various other influences as under:

Food Intake	Energy expenditure
Company	Weather,
BMR :	Thyroid staus
Type of food	Thermogenesis
Surroundings	
Physical Activity	
Habits	

Mortality and morbidity

A 10% overweight person has a 13% greater chance of death; while a 20% overweight has 25% greater chance. There is definite increase in morbidity due to diabetes mellitus, hypertension, IHD and strokes.

Obesity is judged more by appearances and by skin fold thickness than the standard height/weight charts. Without going in for the complicated techniques, one may assume that any weight gain after growing age (Males 24, females 20) is due to fat only.

More scientifically, we speak of the body mass index (BMI) which can be calculated from the body weight and height of the individual.

$$\text{Body -Mass Index} = \frac{\text{Body Weight in KG}}{\text{Height in meters squared}}$$

Body-mass index of 18 is probably ideal, below which an individual may be called as underweight. 18-25 is the normal range, above 25 one is labeled as overweight, while very obese persons may have BMI of about 40 !

Complications of obesity : Everyone of us must become aware of the ill effects of obesity. In fact the common usage of the term "healthy" applied to overweight individuals should be discouraged.

Psychological effects: Overweight individuals are pre-occupied for their overweight status. Many a times they are made jokes of and sometimes they become the victims of self-deprecation and psychological depression.

Osteoarthritis of knees: In almost any obese individual some degree of osteoarthritis of the knees is inevitable. So that they develop pain in knees by the age of 50 and walk with a waddling gait.

Varicose veins: Tortuous veins in the legs result from damage to their valves, they become painful as more and more valves get damaged.

Hypertension or high blood pressure, with all its attendant dangers is directly related with obesity and it has been documented that a weight reduction brings the blood pressure down without the use of drugs.

Hiatus hernia: A large accumulation of fat in the abdominal cavity pushes the uppermost part of stomach into the thorax through the diaphragmatic aperture. This can lead to symptoms such as heartburn and sour regurgitation.

Breathlessness: An average obese individual is all the time carrying an extra load of fat of about 15-20 kg. For this reason alone one can become breathless while climbing up stairs. However, this is not all. The extra fat has its own blood supply and in this way puts some demand on the heart. There is an associated increase in blood pressure. All these factors may lead to a mild heart failure; which also may contribute to the breathlessness experienced by obese individuals. Weight reduction may reduce the symptoms.

Sleep Apnoea: A grossly obese individual who has about 20 kg extra fat in the body has about 300-400 g extra fat in the tissues of the throat and back of tongue. Snoring is a common problem. In these individuals; when they sleep, the tongue falls back and closes the throat. A chocking sensation results which awakes the patient from sleep. There are almost 20-50 awakenings per night with the result that the individual becomes sleep-deprived and feels drowsy in the daytime. Of late "CPAP therapy" has been developed for such sufferers: It is given using a machine which delivers positive pressure breathing through a tube fitted in the mouth. The person has to sleep with the gadget put on with the tube in his mouth and tied securely to the head!

Coronary Heart Disease: Both sudden deaths and clinically documented heart attacks are more common in obese people,

especially males, while females suffer from-

Gallstones. They can be found in any fat female of forty on ultrasonography.

Transient Ischemic attacks and strokes: Occur due to deposition of cholesterol-rich material in the inner lining of the arteries of the brain. Just some day such partially closed artery closes completely and gives rise to a stroke. It can take several forms, the most common being a paralysis of half of the body (hemiplegia)

Post-operative complications: Surgeons always fear operating upon the obese individuals. They may suffer increased incidence of post-operative complication such as thrombo-embolic phenomena etc.

Diabetes-(NIDDM): It is not unusual to see an obese person become a diabetic. In fact obesity is always associated with insulin resistance- a lack of effectiveness of insulin- the blood sugar lowering hormone.

Back Problems: Since the enlarged, protuberant abdomen changes the way a person stands, it deforms the backbone and leads to what is known as spondylolisthesis. Once acquired, the wrong posture can not be corrected unless the excess of body fat is got rid of.

Menstrual Irregularities are pretty common in obese women and so is- Infertility

Proneness to accidents: Obese persons cannot balance their weight and often fall down in doing normal routine activities. Sometimes it leads to fractures.

Management of obesity

Dietary Control: This is probably the only way available to reduce body weight in obese persons. If we take into account the daily calorie consumption as around 2200-2400 Cals and the fact that 1G of fat produces 9 Cals then it can be calculated that a totally fasting individual will lose around 250 G of fat per day. When the obvious weight loss is much more than this; it is due to the loss of water and electrolytes and which is soon regained once normal diet is resumed.

If not totally fasting, one must reduce the total calorie content of the food drastically without compromising with the daily intake of vitamins, electrolytes and water. This can be achieved in one of several ways.

a. By cutting down cooked food and replacing it with fruit: Thus one can replace the lunch with watermelons, cucumber, tomatoes, papaya, guava etc. In olden days there was a lot of stress on *'phalahar'* (Living on fruit diet)

b. By specifying some day of every week for fasting; In olden times people used to undertake some weekly fasts during which they won't eat anything but water. Some people observe fasts with *'phalahar'*.

c.Crash dieting is not said to be good because although weight loss occurs pretty rapidly, the lost weight is equally quickly gained back

Fruits do not contain proteins but they contain lots of amino acids. Some of their sourness and sweetness is because of this. It is possible to maintain normal health on an "only fruit" diet. While फलाहारी *(Phalaharis)* eat only fruit; some others stay without the use of fire: *niragni* (निरग्नि) In addition, such persons may be obtaining some protein from nuts and dry fruit such as cashew, almonds and walnut that they consume and which are rich sources of proteins.

Behavioural modifications:

1. Eatables should not be perceived as rewards for having done a day's hard work.

2. Some creative activity should always form a part of the daily schedule in order to keep oneself busy.

3. In this regard one must not bow down to pressures of the companions on how much to eat and should decide on one's own when to stop.

Drug therapy with appetite suppressants: has been tried with fenfluramine which is a central noradrenergic drug and more recently with sibutramine which is a central 5HT agonist.

Surgical management: It is interesting to note what drastic measures have been developed by surgeons to reduce food intake! Some examples are as under:

Wiring the jaws
Gastroplasty
Gastric Banding
Gastric Bypass
Liposuction

However, it must be remembered that reduced food intake after surgical procedures or even appetite suppressants does produce the same sensation of general weakness and fatigue as occurs after having taken reduced diet.

Prevention: preventing obesity must always be the goal because obese people find it difficult to maintain any weight loss that they have achieved. All children as well as young and old adults should be motivated to reduce and maintain normal weight.

Despite all arguments an individual is definitely responsible for not maintaining normal body weight. If one weighs oneself regularly any increase in body weight should be immediately obvious when it is of the grade of 1-2 kg. Then it is possible to take corrective measures.

2.Peptic ulcer and non-ulcer-dyspepsia:.

All peptic ulcers are formed by mainly two causes: these are 1.The drugs called non-steroidal anti-inflammatory drugs (NSAIDS) and 2. The organism *Helicobactor pylori*. As we know the organism *H. Pylori* is microaerophilic and settles down in the pyloric mucosa. It produces an enzyme urease with which it splits urea into ammonia and in this way creates an alkaline surrounding for itself which allows it to live in the highly acidic environment.Culturing the organism has been difficult because it requires special media and an atmosphere of 10% carbon-dioxide.It has been recommended that it should be cultured in a candle jar. Ina water bed, a candle is lit and then it is covered with a bell jar. Thecandle consumes the oxygen and releases enough carbon-dioxide to facilitate the growth of the organism.However, evedry day for just five minutes atmospheric air is allowed to enter in; the growth

will stop immediately even if again the candle is lit and anerobic conditions created again.

Another fact which seems to have escaped attention is the cause why H.pylori cannot colonise in the fundus region of the stomach. The cause for this appears to be the fact that the fundus of the stomach often contains an air bubble which must be responsible for inhibiting the colonization there. If by some means we could move the air bubble to the pyloric region it would be possible to combat the H. pylori infection without drugs.

Aerophagy is immunological! : Aerophgy which is commonly considered as a symptom of H.pylori infection seems to be an effort of the immune system to inhibit anaerobic organisms like H.pylori by sucking in air into the stomach.Here the upright posture of the human beings is a deterrant because of which the organism H.pylori gets an opportunity to settle down in the pyloric region.It has been well recognised that other manifestations of disease such as fever and diarrhoea are immunological; it should also be recognised that aerophagy is immulological and one should aim at treating anarobic infection in a patient having aerophagy.

Since growth of H.pylori is facilitated by carbon-dioxide, it is obvious that it is not wise to consume carbonated drinks.

Let us now see what yoga can do in this regard.....

In yoga an internal cleansing procedure has been described as Vata-sara (Movement of air through the gut). At this stage it is worthwhile reviewing the normal esophageal motility.

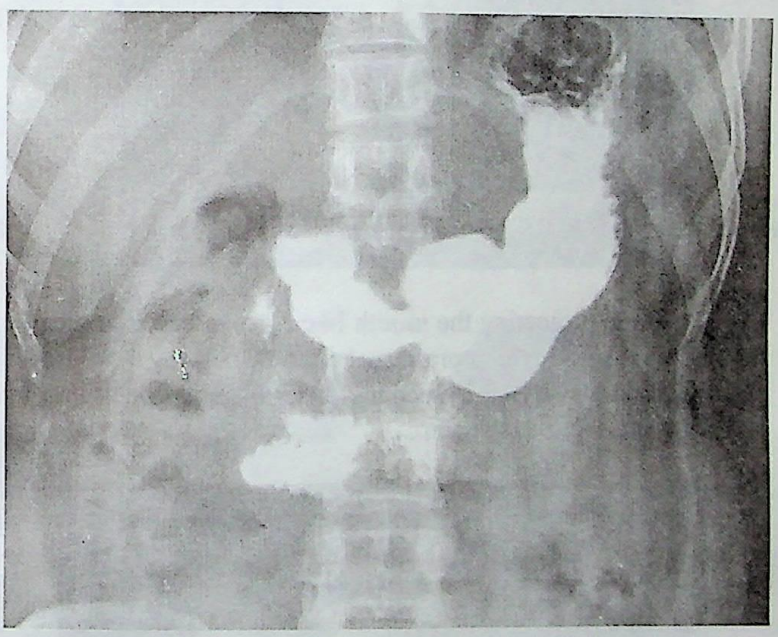
The esophagus shows peristaltic movements which are responsible for the transport of swallowed food from the gullet to the stomach. However, its motility differs from that of the small intestines in several respects.

1. In the esophagus; in the resting state there is no peristaltic activity going on. It lies as a dorsoventrally flattened structure.

2. A peristaltic wave is initiated by the act of swallowing, and thiswave is able to transport food material even in an upside-down posture. As is known very well, the act of swallowing is done

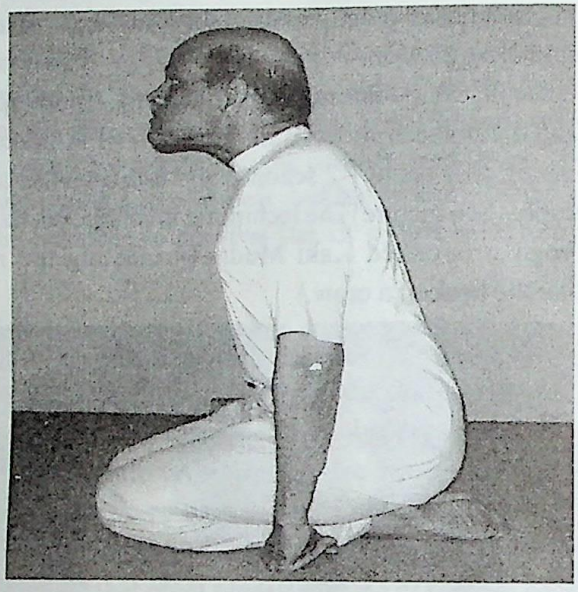
about 200 times in a day while eating food or drinking water voluntarily; and about 500 times just for swallowing the saliva and the throat secretionsand mostly involuntarily. Even in sleep this swallowing activity goes on.

3.Once in a while the esophagus sudeenly opens up like a rigid pipe and the stomach sucks in air. This activity is momentary, normally lasting only about 1-2 seconds and is difficult to capture in a radiograph. (See picture)The technique involved can be learnt easily. In yoga it is called Kaki Mudra.(Projecting the mouth forwards like the beak of a crow.)

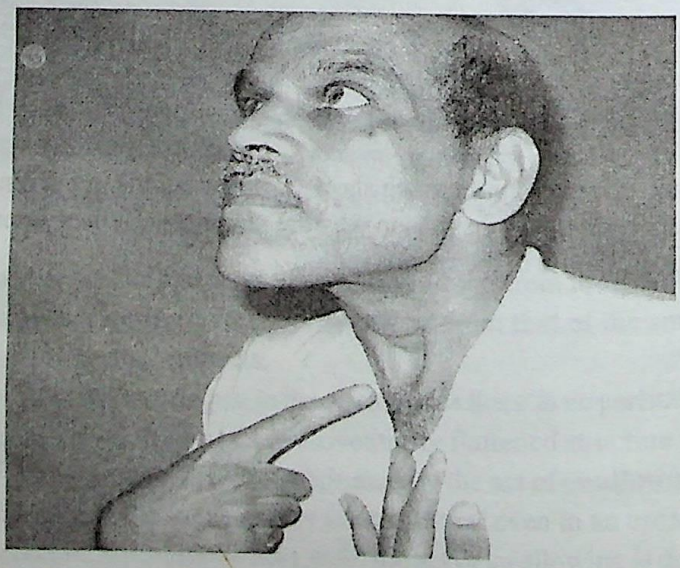


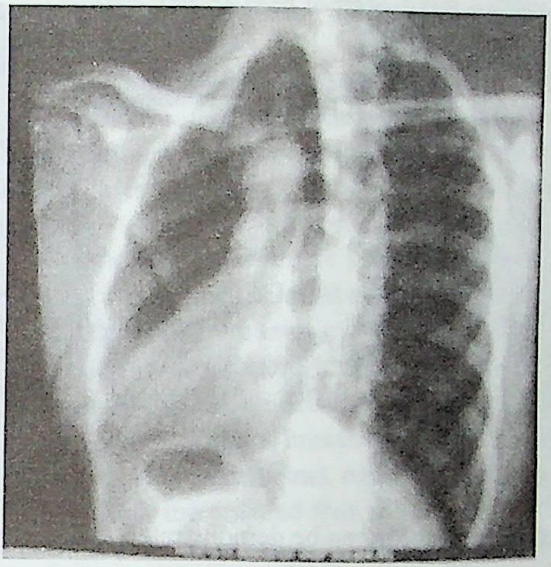
Barium X-ray of the stomach showing an air bubble in the fundus. It seems that this is the reason why the organisms Helicobacter pylori do not settle in the fundus region

Kaki-mudra is performed by protruding the neck like the beak of a crow.

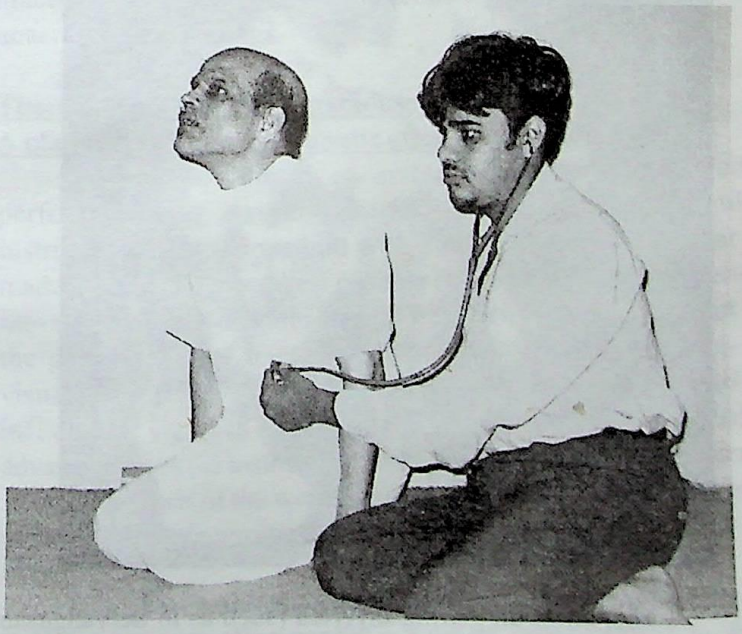


While projecting the mouth like a crow's beak, a pit-like depression is seen in the suprasternal notch. On trying 4-5 times in succession after every 10-15 seconds the esophagus opens up fully and air gushes in the stomach ....

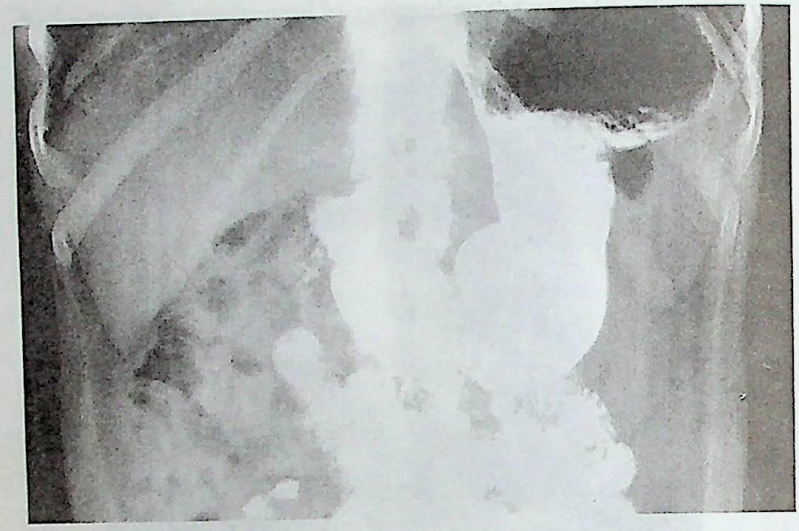




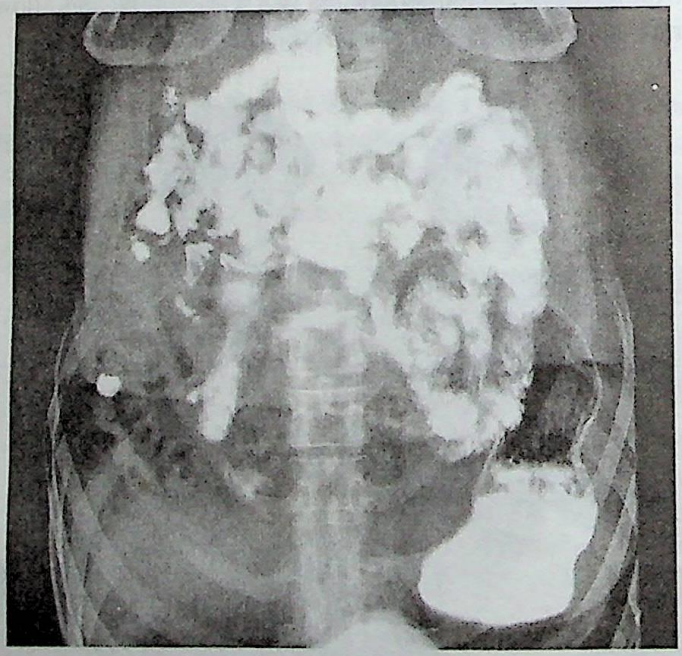
Kaki Mudra opens up the esophagus like a wide pipe and allows free entry of air into the stomach through it.



...and an observer can listen to the gurgling sound so produced applying the chest piece of a stethoscope over the stomach region . If we repeat the X-ray after this...



..the size of the air bubble can be demonstrated to have increased severalfolds.



Thereafter on getting inverted (such as in Sarvangasana, shirshasana or halasana) the enlarged air bubble can be made to reach the pylorus region, and even it can be seen that the air crosses the pylorus and reaches the duodenum from where, if followed for

some more time it will be seen to pass down further on, into the small intestine.

Even a few minutes exposure to air of the antral/pyloric mucosa everyday may help eradicating the infection from the stomach of millions of people and in some may even bring about healing in the ulcer.

3.Amoebiasis: Amoebiasis is a common problem in our country where 80% of the population is said to harbour *Entamoeba histolytica* in the intestines. Almost all are cyst-passers, by which we mean that their stool contains cysts of amoebae. Most of such individuals are symptomless. That shows that out system has adjusted so well with the amoebae that we have a peaceful co-existence for millions of years. Immunologically, it seems that since amoebae are anaerobic organisms, our immune system has learnt to pass air through the gut and that is the reason why amoebae remain inhibited. It seems that in some individuals, somehow thecirculation of air gets disturbed and it is then that the amoebae are able to aquire the trophozoite form and invade the colonic mucosa. Once within the submucous layer they are safe in an anaerobic surroundings.

Therapeutic effects of Sigmoidoscopy:
A placebo effect or therapeutic effect of insufflated air ??

Sigmoidoscopy is an investigative procedure; usually performed using a rigid sigmoidoscope which is a tube-like instrument, 30 cms long and with 2 cm diameter. The patient is made to sit in the knee-chest position and the instrument is inserted into the anus after due lubrication. With this, the lowermost part of the gastrointestinal tract -the sigmoid colon and the rectum- is visualized directly. As a part of the procedure, some air is used to inflate the sigmoid colon to aid in visualization and make advancement of the instrument easier. Everyday hundreds of patients in different parts of the world undergo sigmoidoscopy in the hands of several gasroenterologists.

It is a common experience of a number of gastroenterologists that the patients often report a marked improvement in their symptoms of 'frequent bowel habit' and 'mucus formation' after the procedure; and this beneficial effect may last several days to

months. We, as doctors; and in our close circles we have discussed and often made fun of such patients. How a procedure designed for diagnosis of an ailment can prove therapeutically beneficial! – we have wondered. Most of us have attributed any improvement in the patient's symptoms which he attributes to sigmoidoscopy to a placebo effect (psychologically generated beneficial effect). However, such a view is seriously challengeable and there is no evidence that improvement in patient's symptoms that occurs after a sigmoidoscopy is due to a placebo effect. **On the other hand, it is quite obvious that the insufflation of air is capable of inhibiting** anaerobic organisms, especially the ***Entamoeba histolytica.*** It is going to be a difficult task to disprove this, as, then one would have to perform sigmoidoscopy using nitrogen for insufflation and even then it may not be possible to prevent atmospheric air from entering the rectum once a patient is made to sit in that particular posture. In yoga, in several asanas like the sarvangasana ans the shirshasana if the anal aperture is let loose air can enter the anus and inhibit the amoebae. In persons having a very tight anal sphincter, a small tube-like instrument may first be inserted into the anus and then the asana may be performed.

4.Gall stones :

Cholelithiasis or gall stone disease is quite common. There are two types of stones, the calcium bilirubinate stones and the cholesterol stones. Three factors operate in the formation of gall stones: Stasis- Stones form in the gall bladder where the bile is stored and not in the bile duct where the bile is flowing. Second is supersaturation of cholesterol. Cholesterol is maintained in soluble state in micelles by bile salts and lecithin. The third factor is an altered motility of the gall bladder which impairs the complete emptying and favours the formation of sludge -a kind of mud- in it.

The 'sludge' changes its position according to the patient's posture. At this stage; when no stone has yet formed, shankh-prakshalana can help by stimulating the gall bladder to contract fully whereby the sludge along with the contained bile is washed out.

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The 'sludge' changes its position according to the patient's posture. At this stage; when no stone has yet formed, shankh-prakshalana can help by stimulating the gall bladder to contract fully whereby the sludge along with the contained bile is washed out.

5. Diabetes Mellitus, Hypertension, Ischaemic heart disease

These diseases comprise of a full spectrum from a very mild illness which does not interfere with the work of the patient to very severe life threatening complications like LVF, triopathy and multiple organ failure. Hence no one regime can be prescribed in yoga for all these ailments. It is best to advise the patient to continue the prescribed medicines as before, plus add a few yogic practices to the regime. As the patient recovers from the illness and becomes able to perform more yogic practices the medication may be withdrawn and the patient urged to adopt to the lifestyle completely. In all cases it is best to motivate the younger generation-the children of the sufferers of such diseases- saying that since they have inherited the same genes as their parents; they must pay more attention to preventing these genes from causing disease rather than running from pillar to post after having developed one.

It must be understood that the yoga-asanas also protect the heart by an indirect action : they create a huge oxygen-debt capacity

months. We, as doctors; and in our close circles we have discussed and often made fun of such patients. How a procedure designed for diagnosis of an ailment can prove therapeutically beneficial! – we have wondered. Most of us have attributed any improvement in the patient's symptoms which he attributes to sigmoidoscopy to a placebo effect (psychologically generated beneficial effect). However, such a view is seriously challengeable and there is no evidence that improvement in patient's symptoms that occurs after a sigmoidoscopy is due to a placebo effect. **On the other hand, it is quite obvious that the insufflation of air is capable of inhibiting** anaerobic organisms, especially the ***Entamoeba histolytica.*** It is going to be a difficult task to disprove this, as, then one would have to perform sigmoidoscopy using nitrogen for insufflation and even then it may not be possible to prevent atmospheric air from entering the rectum once a patient is made to sit in that particular posture. In yoga, in several asanas like the sarvangasana ans the shirshasana if the anal aperture is let loose air can enter the anus and inhibit the amoebae. In persons having a very tight anal sphincter, a small tube-like instrument may first be inserted into the anus and then the asana may be performed.

4.Gall stones :

Cholelithiasis or gall stone disease is quite common. There are two types of stones, the calcium bilirubinate stones and the cholesterol stones. Three factors operate in the formation of gall stones: Stasis- Stones form in the gall bladder where the bile is stored and not in the bile duct where the bile is flowing. Second is supersaturation of cholesterol. Cholesterol is maintained in soluble state in micelles by bile salts and lecithin. The third factor is an altered motility of the gall bladder which impairs the complete emptying and favours the formation of sludge -a kind of mud- in it.

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in the skeletal muscles. Such trained muscles do not put an immediate demand on the heart with every trivial activity.Patients of coronary heart disease suffer additional risk if they are anaemic also at the same time. Use of pranayama can stimulate the bone marrow and improve the haemoglobin content.

Pranayama causes hypoxia and that is what protects the heart by leading to formation of coronary collaterals.!

In today's scenario when every yoga teacher and guru is telling the world that pranayama provides 'extra oxygen' to the system and washes out all the garbage present in the blood – if I tell you that pranayama can actually reduce oxygen saturation you may well get agitated and there are chances that either you will leave the book in disgust or that you will start planning to sue me for hurting your sentiments.

However, that is precisely what I am going to tell you here: Hypoxic effects of pranayama and how it helps in formation of new blood vessels in the heart: a 'natural byepass.'

In cardiology, the subject has been very lucidly discussed by Jeroen Koerselman: 'Coronary Collaterals- An Important and Underexposed Aspect of Coronary Artery Disease' *(Circulation.* 2003;107:2507)

Coronary collaterals, or "natural bypasses," are anastomotic connections without an intervening capillary bed between portions of the same coronary artery and between different coronary arteries. Collateral circulation offers an important alternative source of blood supply when the original vessels fail to provide sufficient blood. Timely enlargement of collaterals may even avoid transmural myocardial infarction (MI) and death in symptomatic patients. In 1956, Baroldi and co-workers demonstrated that at birth normal human hearts are endowed with some corkscrew-shaped collaterals with a lumen diameter of 20 to 350 μm and lengths ranging from 1 or 2 cm to 4 or 5 cm. At autopsies it is commonly seen that in the hearts of patients with coronary artery disease those with a long history of angina show more collateral channels. They suggested

that functional coronary collateral circulation results from hypertrophy of vessels, present in normal hearts. In 1964 it was shown that the longer the history of angina, the larger the number of large-caliber coronary collaterals at postmortem examination. Since the resistance of a blood vessel is proportionate to the fourth power of its radius, when we translate lumen diameter measurements into capacity for blood flow, the functional importance of a few large channels is enormous compared with a large number of small channels. Since then, much research has been performed with the goal of understanding the mechanisms of collateral vessel growth: vasculogenesis, angiogenesis, and arteriogenesis.

Vasculogenesis refers to the initial events in vascular growth, in which endothelial cell precursors (angioblasts) migrate to discrete locations, differentiate in situ, and assemble into solid endothelial cords, later forming a plexus with endocardial tubes. The term angiogenesis was formerly used to describe the formation of new capillaries by sprouting out from preexisting postcapillary venules. Currently, angiogenesis is considered the subsequent growth, expansion, and remodeling of these primitive vessels into a complex, mature vascular network. Finally, arteriogenesis refers to the transformation of preexisting (collateral) arterioles into functional (muscular) collateral arteries, as a thick muscular coat is added, concomitant with acquisition of viscoelastic and vasomotor properties.

Risk Factors of Coronary Artery disease (CAD)

The pathogenesis of atherosclerosis and the risk factors for the initiation and progression of the disorder are well known. .Factors strongly associated with CAD, include (among others) age, male gender, smoking, elevated serum cholesterol, disturbed carbohydrate metabolism, and elevated blood pressure. This knowledge, however, does not fully explain why certain persons get symptoms while others do not and why certain persons suffer from angina while others go on to develop acute myocardial infarction. Probably, apart from the extent of coronary atherosclerosis, the sensitivity of organs to episodes of ischemia is of importance.

Therefore, other factors may play a role as well: notably, the presence of a collateral circulation. An organ may be less sensitive to episodes of ischemia if it is supplied with sufficient blood flow by well-developed collateral vessels. Coronary collaterals thus may protect the heart and prevent ischemic cardiac events.

Determinants of Coronary Collateral Circulation

1.Myocardial Ischemia

Recurrent and severe myocardial ischemia is assumed to stimulate the development of coronary collateral circulation. It is now well known that coronary collaterals develop in response to intermittent myocardial ischemia and that these collaterals are preserved even if they are closed at rest, in order to offer immediately function on acute coronary artery occlusion, after recruitment. Myocardial ischemia, per se, can be a sufficient stimulus to induce coronary collateral development, possibly through biochemical signals, including release of angiogenic growth factors. Exposure to low oxygen levels, both in vitro and in vivo, induce accumulation of vascular endothelial growth factor (VEGF) mRNA. Many other genes directly or indirectly involved in angiogenesis are also upregulated in response to hypoxia—among others, the VEGF receptors and transforming growth factor (TGF)-ß. A transcriptional complex, composed of hypoxia inducible factors, serves to augment expression of several of the genes involved in angiogenesis and cell survival.

2.Pressure gradients and shear stress:

The growth of collatral is flow-dependant.Flow in a collateral channel depends upon the degree of obstruction in the parent vessel.The growth of collateral arteries through arteriogenesis is not dependent on ischemia. Collateral arteries develop in nonhypoxic tissue. Whereas angiogenesis is induced by hypoxia, arteriogenesis is induced by an increase in shear stress. The chemokines and growth factors involved in both processes also differ. Factors inducing angiogenesis (among others, TGF- , VEGF, and basic fibroblast growth factor [b-FGF]) induce proliferation of endothelial cells, whereas factors stimulating arteriogenesis (among others, TGF-ß, granulocyte-macrophage colony-stimulating factor [GM-CSF], and b-FGF) also induce proliferation of smooth muscle cells.

However, it is arguable that once the basic framework of hypoxia-induced network of capillaries is availble,it can grow into a mature network of arterioles when ultimately the pressure differences develop due to atherosclerotic occlusion of a coronary artery anywhere in the tree.

The secret of cuccess of Bhastrika pranayama

On the basis of physiological effect produced, one can differentiate betwen a 'Bastrika-followed-by-Kumbhaka' and 'Bhastrika-followed- by-Shunyak'(Bahya Kumbhaka).

In our studies with pranayama using a pulse oximeter we have seen that Bhastrika pranayama can produce more hypoxia if followed by 'shunyak'(Also called as Bahya-kumbhaka) that is breath-holding in full expiration; and can stimulate angiogenesis better; rather than if followed by antar-kumbhaka(Breath-holding in full inspiration).We have observed that in the 1-minute breathholding that is possible after a 1½-minute hyperventilation the SpO_2 can be brought to as low as 78%.Those who are regularly performing Bhastrika pranayama must be inducing hypoxia of the grade of SpO_2 of even lower than78% there must be some angiogenesis going on and in several months it can lead to formation of a groundwork of capillary nets which can come to the use of the myocardium if other factors are also supporting.

There is lack of uniformity in advising how to perform bhastrika. Some practitioners of yoga advice taking a deep breath at the end of a hyperventilation spell and then no hypoxia may be produced at all and at least this beneficial effect would be lost. Others even advise to avoid Bhatrika for hypertensive and coronary patients which is the right thing to do; however, in my opinion, if done under medical supervision Bhastrika can be used to induce angiogenesis in CAD patients On the basis of our studies we can say that if correctly performed, **Bhastrika pranayama has the potential to create anoxia of the grade of SpO_2 60 or below. Such anoxia can act as a stimulus for formation of collateral channels in the coronary tree.** There is a lot of difference in the method adopted and taught by different yoga teachers; once a scientific approach is adopted some uniformity is expected to come.

In summary, to protect ourselves from coronary artery disease a multi-pronged strategy has to be adopted.....

1. Creating hypoxia stimulates formation of collaterals in the coronary tree.

2.At the same time it builds up the haemoglobin level and improves the oxygen carrying capacity of the blood.

3. Yogasanas create a peripheral store of oxygen and make the muscles more capable of oxygen debt. Such trained muscles do not put a strain on the heart with every trivial activity.

4. Increased parasympathetic dominance achieved through practice of convergence, trataka,induction of vomitings, and suryabhedana pranayama bring about favourable changes in the state of mind, more friendly and less hostile nature may emerge. Also associated with parasympathetic dominmance are lowered levels of fibrinogen and lowered platelet aggregability, all contributing to reduced cardiovascular accidents and mortality!

And all this for the price of just one to one-and a half hours a day !

IX

Hatha-Yoga as manipulator of nature

आमकुम्भ इवाम्भः स्थो जीर्यमाणः सदा घटः ।
योगानलेन संदह्य घट शुद्धिं समाचरेत् ।। घे.स.1/8

(The human frame is mere earthenware. Bake it with the flame of Yoga-fire.)

Some people confuse yoga with normal, natural living. They say: if in nature you are required to walk several kilometers a day, walk several kilometers a day. They say: the human body was made in such a way that a long walk will be required. Since we are not required to vomit out things we have eaten, why should the yogis attempt to vomit out things they have eaten? Why do they perform *shankh prakshalana*? When in nature are we required to drink several litres of water and pass it down through the intestines in the form of loose motions? Is it not all un-natural ?

But then, in nature we were all created to produce more and more children; of which few would survive. In nature this mechanism of 'survival of the fittest' has always been there. In nature all were not intended to live long. Most of us would have died in our infancy and childhood due to diarrheas, pneumonias, smallpox and the like. As adults, too, eating to saturate our appetites and doing no physical effort at all if the food is plentiful we would have died of obesity, diabetes and heart attacks.

Therefore for such people I want to make it clear that yoga is not about living naturally. Yoga does not speak of breathing naturally or produce children naturally or even dying naturally. Yoga is about conquering nature. It is: manipulating nature. In a way it is befooling nature. Yoga is just as manipulative as vaccination. Both have the same purpose: To protect the body from disease. A yogi will say: If the bone marrow gets stimulated with hypoxia, create hypoxia to stimulate the bone marrow. If the ligaments become more elastic by stretching, stretch them everyday. If the bones become stronger by putting weight on them, put weight on them: Your body has enough weight which can be put on any bone by changing the posture. If the anaerobic organisms like *H.pylori* and

amoebae living in your gut can be inhibited by only air, swallow air! All the practices of hatha-yoga are manipulations: Efforts to take control of the physiology; efforts to bring even some of the automatic (autonomic) functions under voluntary control. That is the reason I believe that *yoga-asanas* can be a perfect, even better substitute for any exercise program meant to promote health, least to say about having a morning/evening walk.Stated in Hindi it will be said somewhat in these words:

" योग प्राकृतिक रूप से जीने का नाम नहीं है । योग प्रकृति पर विजय का नाम है । अरे योग तो प्राकृतिक रूप से सांस लेने की बात नहीं करता, यहाँ तक कि योग तो प्राकृतिक रूप से मरने की भी बात नहीं करता ।'

Suggested research topics:

1. A study of therapeutic effects of sigmoidoscopy in amoebiasis: Is it a result of air insufflation?
2. A study of therapeutic effects of rectal insufflation of air in invasive amoebiasis.
3. An endoscopic study of effects of deliberate ingestion of air using yogic Kaki-mudra followed by inverted postures in *H. Pylori* infections and colonic amoebiasis.
4. A study of effects of *uddiyan bandh* (a yogic process which is reverse of Valsalva's maneuver) on erythropoietin levels.
5. Pulse oximetry during Suryabhedana, Sahita and Bhastrika Pranayama.
6. Tolerance of hypercapnoea after regular suryabhedana pranayama.
7. A study of changes in muscle tissue after prolonged, regular anaerobic exercises (Yogasanas)
8. A study of the effects of effortful convergence of eyes on parasympathetic dominance.
9. A study of effects of effortful tightening of external anal sphincter on parasympathetic dominance.
10. A study of preferential air flow in one or the other nostril in different decubitus postures.
11. A study of PET of cerebral hemispheres during right and left nostril breathing.
12. A study of thermogenesis in hypercapnoea, in deliberate breath-holding (Suryabhedana pranayama)
13. An infra-red study of the whole body to determine the source of heat in suryabhedana pranayama.
14. Bronchodilator effect of Sheetali pranayama.
15. Study of effects of sarvangasana and shirshasana in cases of bronchiectasis.
16. An angiographic study of generation of coronary collaterals after regular bhastrika pranayama followed by shunyaka (Bahya-kumbhaka).

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Yoga Book For Doctors

This book is written by a Doctor of Medicine, who is also a student of physiology and yoga at the same time. While the study of physiology has given the vision, the study and practice of yoga has given the insight. In fact the more you delve deeper in both these subjects the more you feel how complementary they are to each other!

For ages yoga has been considered a subject dependent on faith. The present book keeps away the mythical aspect attached to the practice of yoga and explains in clear physical terms the possible impact of regularly performing the yogic practices on human physiology. One can achieve parasympathetically dominated state which the modern cardiologists desire so much. One can lead a long; disease-free life and even in old age, remain self dependent. One can even learn to undertake voluntary death which is without disease and which is painless -a technique to be used when one feels one has lived long enough.

The present work is primarily targetted towards ourselves -doctors; so that we can start deriving advantages of yogic practices for ourselves as well as for our patients. This book is also understandable by anyone having a working knowledge of biology acquired through reading of common articles published in popular magazines, more preferably of 10+2 level, and is of best use to medical students.

If it is able to stimulate research by physiologists in the field of Yoga the mission of the book will be said to be fulfilled.

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